MUNICIPAL ENGINEERING

VOLUME XLII NUMBER THREE

MARCH, NINETEEN HUNDRED TWELVE

Contracting Practice.*

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EXAMPLES OF COST ANALYSIS CHARTS.

IN line with suggestions in the February issue three examples are given this month showing how each individual may tabulate for future reference the results secured through his cost analysis methods.

It should be borne in mind that these cost analysis charts should be kept up to date, that is, as fast as the new records are secured they should be plotted upon the charts so that they may be compared with past work either confirming or modifying such experience and better qualifying the estimator for new work.

It should also be borne in mind that such a cost analysis chart must be necessarily reduced to a uniform scale of wages, but this in no way makes it difficult either in preparation or use in estimating.

It is not expected that any one job may be maintained at a uniform or definite scale of wages and there will be many rates of pay and men of different trades and different rates and hours, but in the operation of the pay-roll the charge of the hours should be carried forward the same as the total dollars, and this way the average rate of pay is determined again. Every contractor familiar with his own work has a very certain idea about what is his average rate of pay for labor per hour.

It is best to prepare the charts on a basis of say 20 or 25 cents per hour and then reduce or increase as the case may be, this being of course, for work of ordinary labor and very few skilled artisans. To reduce the reading from the chart to a 17½ cent basis from the average of the 20-cent per hour basis, all that is cessary to do is to deduct ⅛. Plate XXX shows the results of numerous jobs of reinforced concrete building work. These jobs covered all designs and classes of structures, viz.; light and heavy reinforced concrete slabs with and without beams and columns. The average of all concrete over the entire area is indicated by the scale giving the inches in thickness within the border of the chart.

Plotting upon this chart the actual cost per cubic yard of jobs of various character, we arrive at a very satisfactory curve line, indicating what may be reasonably expected in new work. Naturally there are a few abnormal cases, generally caused by special conditions.

It should be noted that the average conditions are found between the limits of 5 inches and 8 inches, or an average of 6½ inches at the apex of our curve. Above this limit, as the thickness increases the cost decreases very slowly. Below this limit, as the thickness increases the cost increases very rapidly. This is logical and is an example of the foot-pounds of work accomplished by the laborer.

Plate XXXI is a further example of sewer construction wherein various sizes of the concrete work determine a fluctuating price of labor on concrete per cubic yard. In this case an attempt has also been made to discriminate between that class of work which can be handled over the trench as the work proceeds, the concrete operations being advanced as the work is completed, and second, where the operation must be handled from some little distance and the material wheeled and the plant only advanced at intervals.

On no one of these charts is it to be expected that we can arrive accurately at foot-pounds of work, but, as has been mentioned in all the foregoing articles,

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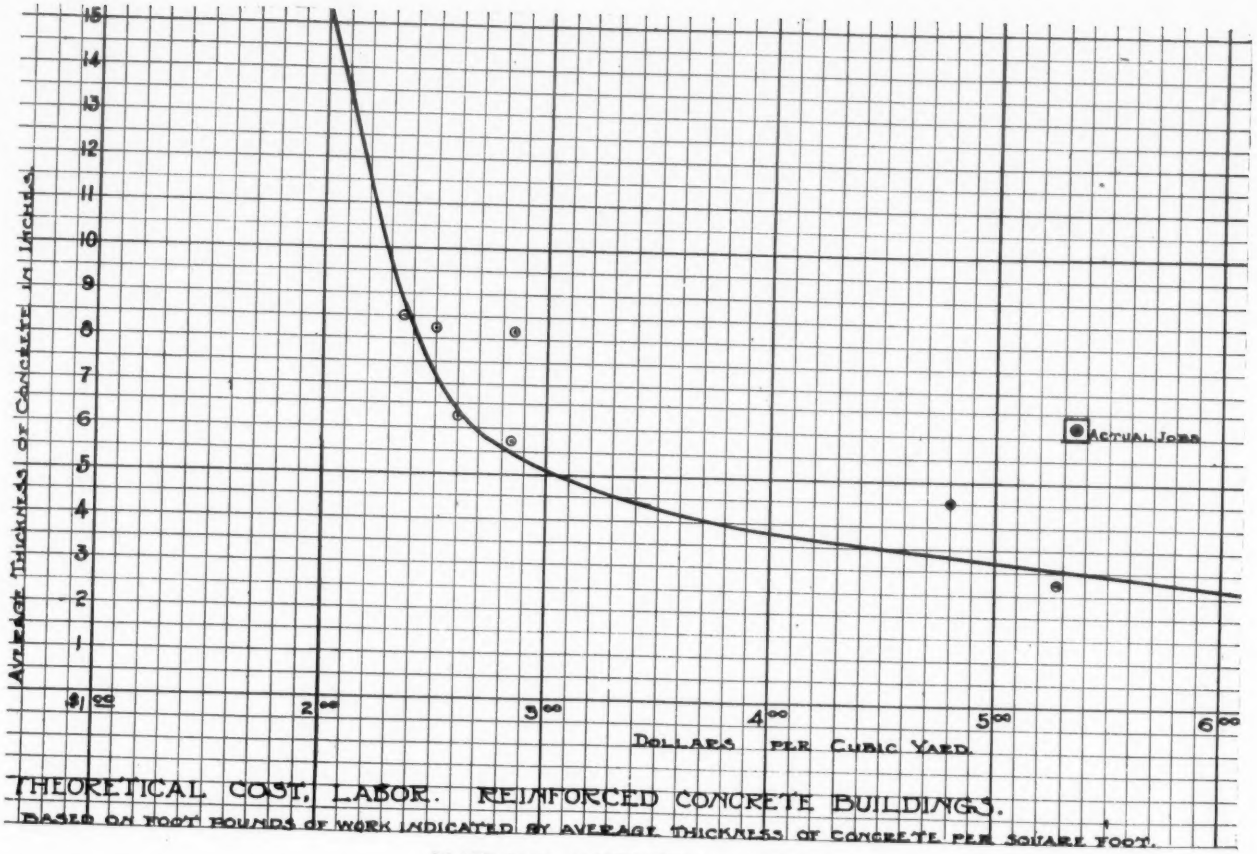
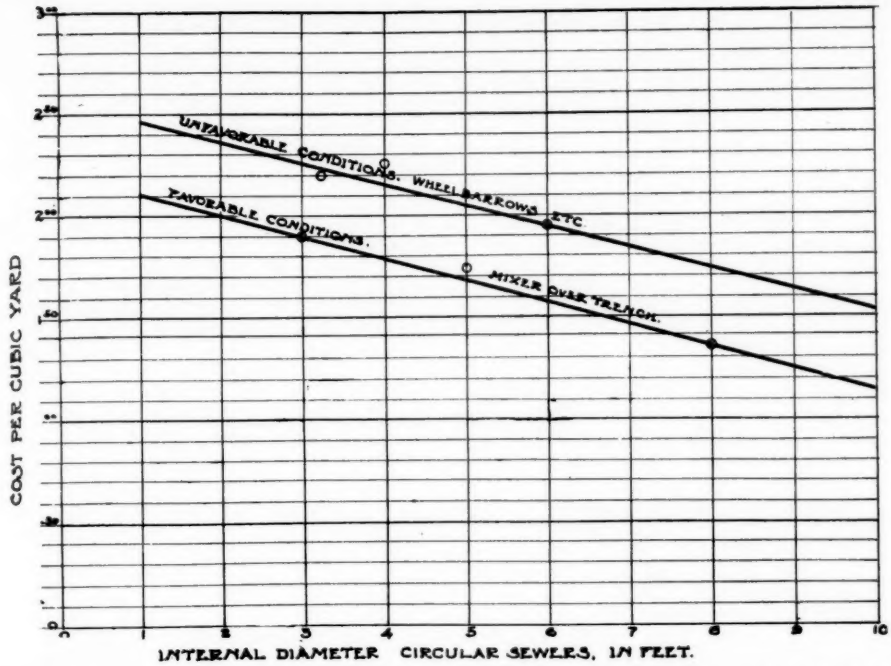


PLATE XXX. CONTRACTING PRACTICE.



THEORETICAL COST. LABOR. CONCRETE SEWERS VARIOUS SIZES.

PLATE XXXI. CONTRACTING PRACTICE.

we are working along a certain definite line of information, wherein, from the time of the preparation of the estimate until the final cost summary of the job, our methods have been harmonious and along a certain definite basis. To the individual contractor the information is of the most value, as the moment a certain job is called to attention, by reference to these charts there is presented to his mind a picture of the particular job, which is explanatory of the results. For this reason it has been brought out time and time again in this series of articles that the value of the methods suggested lies in their constant adaptation to the individual man's work for his own use and his own benefit.

Ruskin says "The crime which bankrupts man and nation is job work declining from the main design to serve a turn here and there." Certainly no really good results can be expected from any system of estimating, bookkeeping, operating cost keeping, and analysis which is not entirely consistent in all its parts.

Plate XXXII shows the analysis of the cost of installation of Blaw steel centers in a number of concrete sewer jobs. This chart is based upon a table from which we arrive at a quite uniform price per square foot for centers of any size of sewer within reasonable limits. The square foot is arbitrarily taken as the complete internal circumference of the sewer, the sewers in this illustration being all circular.

In order to reduce our figures as comparably as possible to a working basis for estimating, and also to present to the eye as clearly as possible a complete summary, we prepare a chart from which we may take directly the cost for labor in cents per lineal foot for labor on centers for sewers of this character.

The same remark applies in this case as to the foregoing to the making of the chart on a uniform rate of pay.

It should be noted that on any of these charts a definite purpose is attained, in that it is much easier to present in such a way the past experience and future probabilities than from scanning a table of figures. Such a chart should, however, not be used without mental analysis of the new job in question and results as shown by the chart should not be used without careful consideration.

Systematic organization demands that it be distinctly understood a system once

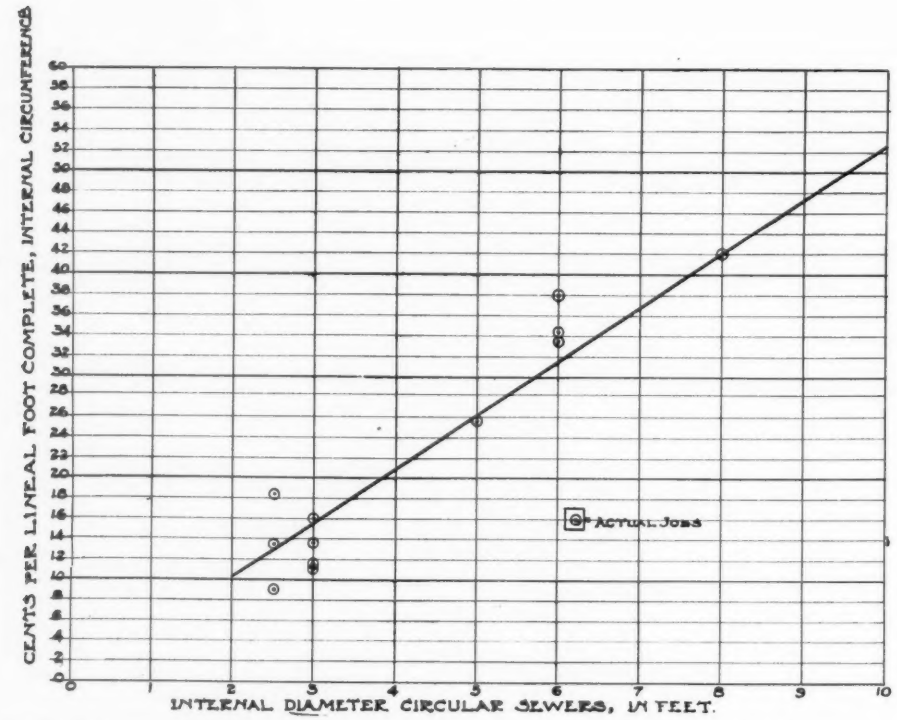
adopted cannot be modified and must not be disturbed or reorganized because of the individual ideas of any one man in the organization. Improvements may be suggested and recorded and worked in as new work demands, but it should be done gradually and the departments correlated.

The hardest task to the contractor is to insure that men employed do not incorporate some particular idea of their own mind by invention or experience in previous employment.

The worth of the final analysis in the preparation of these charts depends upon the individual. It would be a very easy matter for the author of this series of articles to submit thirty instead of three examples but the principles would not be any further advanced by so doing.

It is our intention to incorporate into book form in logical sequence the series of articles which have appeared in MUNICIPAL ENGINEERING during the past ten months, in doing which a larger number of illustrations will be given. Magazine space will not allow us to elaborate along these lines. It is also intended to include in connection with the various departments of work such instructions to workmen as will make this series a complete outline of contracting practice.

In conclusion, if it may be permitted, the author suggests, first, "Any system is better than no system," and second, "Any system results in mental analysis," which after all is the one thing gained.



THEORETICAL COST, LABOR, STEEL CENTERS, SEWER WORK PER LINEAL FOOT.
BASED ON AVERAGE OF FOURTEEN JOBS, - SEVEN DIFFERENT SIZES.

PLATE XXXII. CONTRACTING PRACTICE

Acid Conditions in the Monongahela River.

A VERY complete and detailed study of acid conditions in the Monongahela River has recently been completed by Thomas P. Roberts, of the U. S. Engineer Office, Pittsburg, Pa. The results of this study and suggested means for the mitigation of the evils were recently presented in a paper before the Engineering Society of Western Pennsylvania.

The extreme acidity of the water may be judged from the statement of Mr. Roberts that the river is practically unfit for the navigation of the ordinary type of steamer, and the installation of costly purifying plants is necessary before the water is available for making steam at the various power plants along the river course.

Owners of the steel mills have not made any concerted effort to abate the acid nuisance in the river water, but have one after another chosen instead to invest large sums of money in the erection of softening plants where the water, before it is permitted to reach their boilers, is treated usually with soda ash and lime to neutralize it. The cost of operating softening plants is very considerable, being several hundred dollars daily, in some cases.

Besides the enormous consumption of soda ash in treatment of boiler water, there are establishments where it becomes occasionally necessary, in order to save pipe lines, laid in underground drains, from rapid corrosion, to place great quantities of the soda ash in the drains.

Only a passing reference is made to the damages and expenses incurred by the domestic users of acid water in the Monongahela Valley. Its importance may be imagined from a few words; brass pipes necessary, mistakes in use of household softeners ruining clothing in washing, potable water sold in bottles, etc., etc.

According to the investigations of Charles E. Ashcraft, Junior Assistant United States Engineer, Pittsburg Office, much the largest proportion of the sulphuric acid reaching the river comes from the coal mines. He has ascertained that of the twelve galvanizing establishments on the Monongahela River or its tributaries, eight of them are estimated to use 59,000 tons of acid per annum. The four plants not included in his estimate are very extensive users, and it is probably within the mark to say that 75,000 tons of acid are annually consumed in the district.

It appears that while the records of tests for acids available for study are exceedingly numerous, covering, as they do, daily reports from mills and pumping plants for a number of years past, nevertheless the records have not been coordinated with the river's discharge. This co-ordination would require tests to obtain the mean acidity of the entire river conjointly with measurements of the river's discharge per unit of time.

The best time for making such comparative tests and measurements would be after the passage of a freshet from headwaters which has swept the river from the West Virginia mines to its mouth, so that no areas high in accumulated acid would be left in any of the pools. A favorable opportunity for making this determination under conditions mentioned occurred on September 21, 1911, when the discharge over Dam No. 1 was about 15,000 cu. ft. per second, a decrease from 40,000 feet per second a few days before. Samples were taken from five well distributed points across the river at a point about 100 yards above Dam No. 1. The discharge was represented by about 3.9 feet depth on the crest of the dam for 720 feet of its length. The remaining 200 feet length of the dam was "shut off." For the entire length of the dam the same discharge would have given about three feet depth on its crest. The samples were taken from one foot depth below the surface. The determinations for acid were made by the United States Bureau of Standards at the testing laboratory, Arsenal Park, and were as follows:

No.	Location—Distance from Shore Feet	Aspect of river surface	Velocity—Miles per hour	Free Acid—Grains per gallon	Remarks
1	Forebay of Locks	Clarified	0.00	.099	Right shore.
2	50	"	0.25	.099	Distance from right shore.
3	200	Mottled*	1 00	.086	Distance from right shore.
4	Mid-river	"	1.20	.009	
5	125	Slightly muddy	0.25	.082	Distance from left shore.
	Mean		0.65	.093	

Weather fair and warm. Temperature of river water 70 deg. F.
*By "mottled" is meant minute particles of curdled clay or mud suspended in clear water, but so numerous, that unless examined closely, it might be considered dissolved mud, or "muddy water."

The violent reaction below the dam broke up the curdling process, the color of the river from shore to shore becoming yellowish and nearly opaque. Next day, September 22nd, all of the water approaching the dam appeared to be very nearly clear, the river in the meantime having fallen about 4 inches. With a discharge of 112,500 gallons per second it would appear from the above determination that there is carried daily by the river about 64.5 tons of free acid. With the discharge of the river reduced to 300 cu. ft. per sec., as occurs during ordinary low water periods, the acidity of the river with the same quantity of acid would be increased 50 times, or to 4.65 grains per gallon.

It is necessary to have some clay or "mud" with the acid to produce a good coagulant, such as sulphate of alumina, and, where all the clay is used up, fresh increments of acid entering the river bring about other reactions, causing areas of the river to assume a yellowish color or sometimes a chocolate brown, which might be mistaken for ordinary mud in suspension.

An interesting phenomenon observed by Mr. Roberts at Lock No. 6, 70 miles above Pittsburg, was to see the river as black as ink, though it was really transparent for six inches depth. Such a decided blackness was never seen before at No. 6 and indicated that acid from above in unusual quantities was combining with the tannin from natural sources always carried by Cheat River water, and making a diluted ink. A peculiarity of this very dark water was that when waves dashed it against a rough stony edged shore it developed masses of suds, or foam, floating on the water higher than the sides of skiffs moving through it.

It has been found at some of the locks that in filling them through deeply submerged valves, the water introduced into the lock chambers was higher in acid than surface water. To settle this point, in one of the locks which was closed for repairs, and containing almost perfectly still water, tests were made, with the result that water drawn from twelve feet depth contained considerably more acid than that from near the surface, in the case tried, two grains per gallon more. It would thus appear that there is a tendency in the acid to gravitate towards the bottom, but as to whether in time the surface water would become neutral is an open question.

In speaking of the dangers of the acid condition as related to boiler water, Mr. Roberts says that a very extensive steel plant on the river in Pool No. 3, during the fall of 1910, was on the verge of being closed down owing to the inadequacy of its devices for softening the river water. Never before had the company's chemist noted such acid conditions in the river. The plant would have been shut down had it not been that at the critical time the flashboards on Dam No. 4 were partially lowered in the hope of helping things for some pump and other boats in the Government Service whose boiler tubes were giving much trouble. The stirring up of the river resulting from a sudden increment of water in Pool No. 3 raised the pools below only a few tenths; nevertheless it did a great deal of good, especially to the steel company referred to. Already one of the railroads paralleling the river has extended a pipe line from a service. The situation is only bearable now at a large cost annually for repairs, while the future promises, with the rapid increase in the output of acid, the extinction of the well approved types of engines and boilers at present in use.

The great majority of the steamers place their sole dependence for safety in the use of boiler compounds, but as the proper doses of this material are largely a matter of guess work, there are chances for mistakes. As a rule, however, the engineers are on the safe side and overdose their boilers.

Not only the mills and boating interests but the General Government as well is interested financially in the solution of the problem, for the lock gates, valves, wickets, miter irons, and adjustable tops on the dams along the river are all subject to deterioration and call for frequent attention. While this trouble is present to a greater or less extent at all the locks, it appears in its most aggravated form at Lock No. 2. In this case several inches of metal ¾-inch thick had been corroded from the edges of structural steel pieces which were exposed to the action of water which was flowing in contact with them.

Three years ago the miter sills of the lower gates of the inshore lock were shod with new angle steel ¾-inch thick with top leg on the sill six inches wide, and vertical leg eight inches wide, against which latter the lock gates rested when closed. After the lock was pumped out recently the vertical legs mentioned were found to have been entirely consumed by the acid. Evidently the current in a very thin sheet had passed upward under full lock pressure between the gate and the sill with its angle steel covering. As the gates were not in closed position probably for more than 1-3 of the time, and after further deductions of several months for high water with weak acid conditions in the river, it may be assumed that the corrosion of the ¾ in. metal took place in eight or nine months of effective acid duty. This with acid ranging from two to six grains per gallon in the water.

The action of acid is less rapid in the

outer lock, though all four of its valves have been removed for extensive repairs, and still less rapid farther out in the river, evidencing the fact that the acid was for the most part following the shore from Turtle Creek, which enters the river a few hundred yards above the lock. Turtle Creek water for the most of the time ranges from 8 to 80 grains of acid to the gallon.

In the conclusion of his report Mr. Roberts presents a statement from J. K. Clement, physicist of the U. S. Bureau of Mines, regarding an interesting experiment made at Lock No. 2 on the Monongahela River. The method used in the experiment of the Bureau of Mines is based on the electrolytic theory of corrosion, which is now very generally accepted. According to this theory, when iron is oxidized in the wet way it first goes into solution as ferrous ions. The ferrous ions are then oxidized by the oxygen present in the water to ferric ions, which are then precipitated as ferric hydroxide. At the same time that iron is passing into solution at one part of the surface an equivalent amount of hydrogen is liberated at another point. The passage of the iron from the atomic to the ionic state and of the hydrogen from the ionic to the atomic state is accompanied by a transfer of electricity, the electric current following in the direction from iron to solution at the point where the iron is dissolved and from solution to iron at the point of evolution of hydrogen.

The tendency of metals to go into solution is known as "solution pressure" or "solution tension." The more positive the metal the greater is its solution tension; thus the solution tension of sodium or potassium is very high and that of gold is zero. The solution tension of zinc is greater than that of iron. If, therefore, strips of zinc and iron are immersed in an acid solution and connected through a wire, zinc will pass into solution and hydrogen will be liberated at the surface of the iron. At the same time a current of electricity will flow through the wire from iron to zinc. The principle has been appli d successfully to prevent the corrosion of boiler surfaces.

In preliminary experiments made by F. M. Stanton of the Bureau of Mines, two steel plates, 6 by 8 by ⅛ in., one of which was connected in series with a two-volt accumulator, and a carbon anode, and the other of which was unprotected, were immersed in the Monongahela River near Lock No. 2 for a period of fifteen days. The loss in weight of the protected plate was 0.7 gram and of the unprotected 10.9 grams.

Before immersion each plate was carefully polished on one side. At the conclusion of the test it was found that the unprotected plate was corroded and pitted over its entire surface whereas on the protected plate there was no evidence of corrosion.

Arrangements are now being made for experiments on a larger scale and it is hoped that a method may be developed for the protection of steel against the corrosive action of acid waters.

Practical Road Building.*

By John N. Edy, C. E., Highway Engineer, Billings, Mont.

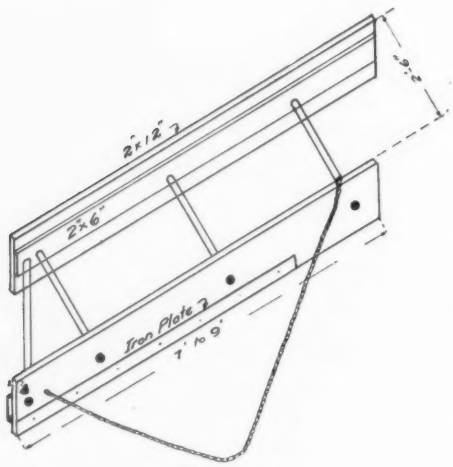
Maintenance of Earth Roads.

MAINTAINING an earth road consists in keeping the weeds down, culverts open, the surface of the road free from ruts and chuckholes, and preserving the crown. But one system of maintenance will be considered, that by means of the road drag. For thoroughness and economy of results the split-log or plank drag has no equal, and it is both cheaply made and easily operated. Not only does this simple tool maintain the road in a smooth condition and preserve the crown, but it kills weeds, prevents chuck-holes, and its use compacts and waterproofs the surface, causing it to offer greater resistance to the abrasive action of traffic.

The principle of drag maintainance is directly opposed to the system of annual re-construction with which we are so familiar. Instead of making a road and leaving it to go to pieces only to be rebuilt at excessive cost, drag maintainance keeps the road in good condition, and actually improves it. Dragged roads get better, instead of worse, with age. The following sketch shows the ordinary type of road drag made of planks. It should be light enough for one man to lift easily, and is used with but one team, dragging at an angle of about 45 degrees with the road. Such a drag may be made by any person of average intelligence, and at a cost of but a few dollars.

*Copyright by John N. Edy.

The drag shown is made as follows: Procure two pieces of light 2x12-inch stuff and two pieces of 2x6-inch, about 8 ft. long; securely fasten the 2x6's along the middle of the 2x12's, as shown, thus approximating the shape of a split log. Place the slabs on the ground in an upright position 2 ft.-6-in. apart with the 2x6's on the inside. The right or ditch end of the front slab extends past the same end of the rear slab as shown. The slabs are fastened together with four hardwood stakes wedged into 2-inch holes. The bottom of the front 2x12-inch is shod with an iron plate, an old wagon tire serving for this purpose. The hitch is made to a chain, the one end of which extends over the top of the front slab and is fastened to the brace stake; the other end passes through a hole near the end of the slab.



I. ROAD DRAG.

The cost of dragging varies with the locality and the condition of the road. The road should be dragged after every rain or other wet spell. At the rate of ten draggings per year, the team costing 60 cents per hour and walking at the rate of two miles an hour, the cost for the year will be $6.00 per mile. A recent report indicates that for the years 1906 to 1909 the cost of maintaining with the drag the earth roads of the state of Iowa averaged but $5.00 per mile per year. Comparing this insignificant expense of a good road with the usual cost of periodic reconstruction, which nets only indifferent results, clearly demonstrates the economy of this system of maintenance.

The road drag preserves the crown and builds up a solid wearing surface by moving material in thin layers into the driveway, each layer being packed by traffic and baked by the sun. It is a mistake, therefore, to move a large mass of loose earth into the middle of the driveway and leave it to obstruct and hinder travel, and to defeat the purpose of the dragging. An experienced man will spread the material evenly as he drags; and if for any reason a ridge of earth is deposited in the middle of the road, the drag should be hitched square with the driveway and the loose material spread evenly. This precaution is to be noted in connection with the use of small, 2-horse graders in "dressing up" a road or street. Leaving clods in the middle of the road drives vehicles into the side ditches, subjecting them to unusual wear and injury. A bulletin on "The Use of the Split Log Drag on Earth Roards" may be obtained free upon application to the U. S. Department of Agriculture. The following brief suggestions are presented:

Use a light, 2-horse drag, so light that you can lift it.

Do not drive too fast.

The driver should ride the drag standing on planks placed on the rods, shifting his weight from side to side to cut or drop material.

Drag when the road is moist but not sticky; the only time the drag will actually injure the road is when it is too dry.

Drag after every rain, melting snow, or, when the frost comes out of the ground.

Drag during the winter thaws to prepare the ground for the next freeze.

Use a grader for grading, and a drag for dragging. Each has its separate and distinct field of usefulness.

The tools required for the work outlined in this chapter are:

Plows; 2 or 4-horse Grader; Harrow; Road Roller; Drag; Slips, Wheelers or Fresnos; Wagons, shovels, picks, etc.; Dynamite.

Note that the list includes a roller; no supervisor is properly equipped unless he has some kind of a road roller. Its use is necessary in building all types of roads and road surfaces. If a steam or horse roller is not on hand, a very serviceable one may be made of concrete as follows: Procure a piece of boiler shell about 5 ft. long and 4 ft. in diameter. Set on end, place an iron shaft in the center, and fill with 1:3:6 concrete. The result is a five-ton roller to which a frame for hitching may be readily attached, and which has cost but little.

Perhaps the most indispensable road tools are those which the supervisor makes himself, namely, the drag and roller.

SAND ROADS.

What has been said in the foregoing is not applicable to sand roads. With a

light sandy soil, that shifts when dry, the object should be to retain enough moisture to add stability and compactness. It requires moisture to compact sand. Because of this condition, sandy roads should be given very little, if any, crown: in fact, it may even be necessary to depress the center of the roadway slightly. In comparatively dry regions, it may be desirable to bring water to the sand road, rather than to permit it to drain away.

However, the proper method of treating a sand road is the addition of clay and the construction of a sand-clay road, which will be described in a later chapter. In this manner, the road surface is improved to a higher state of perfection than is possible with either material used alone.

II. GRADED EARTH ROAD.

Note the loose material thrown to the center, which forces traffic to sides of roadway.

Excellent results have also been obtained by treating sand roads with asphaltic oil. This method will appeal to those communities favorably situated as regards the purchase of oil. A description of this type of road surface will be presented in another chapter.

MISCELLANEOUS SUGGESTIONS TO SUPERVISORS.

1. Drag all earth roads after every rain or other wet spell; drag during winter thaws.
2. In the absence of a roller, drag earth roads and fill during construction.
3. Do earth work in the spring, when the ground is moist and will pack. In doing grader work, never leave a ridge of loose earth in the middle of the roadway; spread the material evenly before rolling or leaving the job.
4. Never dump a scraper in the road and leave the material in a pile. It should be spread as it is dumped.
5. In side-hill work keep the ditch on the upper side of the driveway. In deep cuts, dig intercepting ditches farther up the slope to catch some of the foreign water before it reaches the road, and to keep the banks dry.
6. On earth road grades see that the fall from the center to the sides is greater than the fall *along* the road, so that water will run toward the side-ditches.
7. When a large volume of foreign water must be cared for, use wide, shallow ditches in preference to narrow, deep ones.
8. Be sure that there is a continuous fall from the center to the side-ditch. Keep all weeds down.
9. Never drag a lot of loose earth to the middle of the road and leave it there in a ridge to drive traffic to the sides. Hitch the drag square with the road and spread the earth; a better way is to spread it as the dragging progresses, which can be done after some practice.
10. If ditches "wash", pave the bottoms with flat stones.
11. Never fill a mud-hole with rock.

See special instructions on this point above.

12. Use the proper tool for moving earth.

13. Keep side-ditches free from obstructions of all kinds; report at once any wilful obstruction by residents along the road.

14. Do not use wood box culverts if it can possibly be avoided.

15. Lay all pipe culverts with the bell up stream, and in a trench that is shaped to fit the pipe.

16. Allow at least 18 inches of fill over all pipe culverts: if this involves building up the dump, begin far enough back on each side of the culvert that there will be no pronounced hump over it.

17. Clean away any deposit that may form at the inlet end of the culvert.

18. Keep the barrel of all culverts clean.

19. Replace at once any stone that falls from a culvert head-wall.

20. Use no pipe of less diameter than 12 in. for culvert purposes.

21. When a culvert or bridge is found to be in a dangerous condition, fix it before reporting.

22. Inspect all bridges: see that all nuts are tight and plank securely nailed.

23. Never nail a new plank over an old one; remove the worn piece and replace with the new.

24. Replace all timber culverts with permanent material as quickly as possible.

25. See that all hand rails on bridges are secure.

26. Do not hire poor teams; if the team will not give satisfaction for an individual, the county does not want it.

27. Spend the public money with as much discretion as you do your own.

28. In case of accident to traveller, report immediately, if caused by condition of the road or bridge.

29. Attend the monthly meetings of the supervisors; you can not fail to profit by the discussions.

30. Mail your monthly report regularly on the date specified.

31. Follow such instructions as you may receive from your superior; he will assume the responsibility therefor.

32. Do not contract for supplies without consulting your superior.

33. Remember that ability is not measured by visible results alone; but by these results, together with what they cost the tax-payer.

III. ROAD DRAG IN USE.

Note the angle it makes with the Road and small amount of material pushed to center of road.

The Chloride Process for Water Purification.*

By W. B. Bull, Chicago, Ill.

ABOUT one year ago, while experimenting with a ferrous salt and an alkaline re-agent (both produced electrolytically) that would be an improvement on the iron and lime process used in water purification, quite by accident a ferric salt was produced with its characteristic cherry red precipitate.

It was found that this ferric salt could be produced cheaply, reliably and with certainty in any water works plant large or small, by simple apparatus, and it was later proven by a small experimental plant, set up for the purpose at the Toledo, Ohio, water works, that this ferric salt was the equivalent of sulphate of alumina, both as a coagulant and also as a color or stain remover, for which latter use, the iron and lime process had been unsuccessfully tried at Toledo, to be discarded, and the more expensive sulphate of alumina treatment reluctantly substituted.

It further appeared that, in using this ferric salt, an alkaline re-agent was not needed, in waters that were sufficiently alkaline to precipitate a sulphate of alumina solution, and in consequence, it appeared that the alkaline product of the electrolytic process referred to (caustic soda) was a by-product of great value, and being unnecessary in the coagulating process, the operator was free to dispose of same to his financial advantage, so that in plants of sufficient size, the proceeds of the soda by-products would entirely, or approximately, pay for the cost of producing the coagulating ferric salt.

The above conclusions were based upon power costs at eight cents per horse power per 24 hours (the ascertained cost at Toledo from the producer gas engines at their low service pumping station), salt and iron borings, each at $4.00 per ton, and a salable by-product of caustic soda at $40.00 per ton. The Toledo water works would apparently effect an economy of approximately $20,000.00 per annum, their present expenditures for sulphate of alumina, and accomplish identical results.

The process and apparatus are simple, do not require expert attention and may be thus described:

Using an electrolytic cell, or cells, which by decomposition of salt brine, produce chlorine gas from the positive side and a caustic soda solution from the negative side, the soda solution flows away and is concentrated by a simple procedure, and sold. Caustic soda is as staple a substance as sugar, and in demand everywhere by laundries, soap makers, etc., etc. If a purification plant was too small to warrant the saving and disposition of the caustic product of the process, it would serve a useful purpose as a softening agent in the water supply, or in softening the boiler feed, and if used for softening of the general supply, there would be an unobjectionable chloride of lime resulting, in place of the more or less sulphate of lime, which is produced and left in the water by the present iron and lime process.

The chlorine gas produced from the positive side of the cell is mixed with water, which greedily absorbs it, and this chlorinated water is passed upwards through a conical receptacle, containing fine refuse iron chips or borings, passing off thence as a strong solution of ferric chloride, which is used in the same way as a solution of sulphate of alumina, and is thoroughly precipitated into an insoluble, flocculent hydrate, which, as previously stated, has properties identical to an alumina hydrate, and at a fraction of the cost of the same. Broad method and apparatus patents have issued to the writer on the above.

Upon taking up the business end of the proposition, it was found that there was no great choice of electrolytic cells for chlorine and caustic production available, and the one cell that seemed best suited to this use was held by the owners of the patents at a price which was very burdensome. The cell in question seemed to possess disadvantages that appeared capable of correction, and some nine months ago the writer, and his colleague, William M. Jewell, undertook to construct an electrolytic chlorine and caustic producing cell, that would be efficient, durable, convenient and cheap to build.

It was soon evident that there was very little in English print upon this subject and every step had to be laboriously thrashed out by tedious experimentation. Fortunately, however, with gratifying results, so that a cell has been finally produced that apparently represents the results that were sought for, and which appears to meet the approval of a number of people who are expert in such matters.

It is probable that the cell is now in such shape that rapid progress can be made from now on in the installation and

*A paper before the Indiana Sanitary and Water Supply Association.

demonstration of a process that, by virtue of its merits and great economy may, perhaps, supersede existing methods of treating water chemically, in connection with its clarification, and also its sterilization; for it may be said in addition, that, inasmuch as the ferric chloride solution may be produced to contain any desired amount of free chlorine, it does not seem improbable that one and the same solution would take the place of not only the sulphate of alumina (or sulphate of iron) solution, but also of the hypochlorite solution now so frequently used as a sterilizing agent, as the function of the latter is due entirely to the free chlorine it contains. This latter application is mentioned here simply as a possibility, or rather as a probability, and is something that can be simply and promptly tried and proved or disproved, but in the press of more important features of the case, simply has not been reached as yet. The experiment might have been tried at Toledo, but was overlooked as a possible function of the process, until the experiments had ceased and the apparatus was dismantled.

The name Chloride Process has been used for this new chemical treatment of water, although speaking more strictly, the salt now produced is not a chloride but a perchloride of iron.

In conclusion, to answer inquiries as to approximate cost of an installation of the Chloride Process, which, in view of widely differing conditions and capacities of water works plants is a difficult matter to state, even in general terms, it may be said that an investment in such a coagulating producing plant should show an annual economy equal to a return of not less than 20 per cent on its cost, including interest, depreciation and renewal for a small water works plant, and from that upwards to fifty or more per cent according to the character of the water, amount and cost of coagulating materials at present used, and size and location of the water works plant.

Pneumatic Street Cleaning.*

By C. A. Tripp, Consulting Engineer, Indianapolis, Ind.

IN comparison with the advances made by sanitary science in providing pure water supplies, pure food, and in the disposal of sewage, very little progress has been made in the direction of the gathering and disposal of street wastes, and the prevention of air pollution from street dust.

Quoting from an address by Dr. George A. Soper, president of the Metropolitan Sewerage Commission of New York, before the Boston Society of Civil Engineers:

"The conservation of health has no better field for effective operation than systematic warfare against dust. With one notable exception, the use of oil on thoroughfares and railroads, no new method of combating this evil has been developed by sanitary science in recent years, while the quantities of dust produced enormously increased with the growth of our cities. As matters stand, the greatest dust scavenger is the atmosphere. Into it we cast the dust of our houses with the same heedlessness with which we dump our sewage into the water courses. We do not stop to think that this air must serve to ventilate our dwellings and shops, and the lungs of our children and ourselves.

"If the filthy dust of our streets were to be kept from the lungs by efficient methods of street cleaning, consider the progress in decency and order, not to mention health, which this reform would accomplish."

At the present time probably 90 per cent. of the street cleaning is done by the horse drawn rotary brush which has been in use in substantially its present form for the past 25 years. It is certainly not to the credit of American ingenuity that this has been the case, as the machine is far from a satisfactory one and falls far short of accomplishing its purpose. When used on dry streets it does gather up the heavy dirt, but as a dust producer it can hardly be excelled. If the street is sprinkled before sweeping, the principal result of the brushing is to spread the mud in an even layer over the street and fill the cracks, leaving it in perfect shape to dry and blow away.

From the standpoint of cleanliness, the method of flushing by water under a considerable pressure leaves little to be desired. Machines for this purpose were put on the market a few years ago, and were received with considerable favor. Constant use, however, has shown that the water striking the pavement with

*A paper before the Indiana Engineering Society.

the force necessary for satisfactory work, has a very injurious effect, particularly upon asphalt and bitulithic surfaces. The amount of water used, approximately 2 gallons per square yard, makes this a serious item of expense. Furthermore, the street dirt is only transferred to the sewers, where a large part of it settles in the catch basins and must be removed. This latter item of course does not appear in the street cleaning cost but is a real and very considerable item, nevertheless.

The general attention which is being attracted by the damage done by this method is well shown by the following letter from Mr. J. W. Howard, Consulting Engineer on Roads, Streets and Pavements, published in *Engineering-Contracting*.

FLUSHING PAVEMENTS WITH WATER UNDER PRESSURE.

"Sirs: The above heading is quoted from an article, page 307, of May issue of MUNICIPAL ENGINEERING, entitled "Causes and Defects in Asphalt Pavements," by Isaac Van Trump, Chicago, Ill. The article includes "flushing with water under high pressure" as one of the "causes of defects in asphalt pavements which are almost entirely under the control of the municipal engineer," and adds, "it is entirely unfair to the municipality, the taxpayer and the contractor for the municipal engineer through ignorance or neglect to permit conditions to exist during the construction or after the street has been completed, that will permanently impair the usefulness or appearance of the thoroughfare." This is sound advice from one who has closely watched the evils of the high pressure flushing system of street cleaning; but what heed does the city of Chicago pay to its and some other cities' technical advisers? In the current number of another engineering journal we find a half-page photograph of "one of Chicago's 41 new flushing machines" forcing water, from about one foot above it, under pressure, on the surface of the pavement. Is it any wonder that contractors and surety companies in Chicago and elsewhere are repudiating their guarantees, as shown by an able paper in 1907 by John W. Hittell, Chicago's Chief Engineer of Highways, before the American Society of Municipal Improvements."

The writer and others who have had long experience with the construction and maintenance of pavements, have condemned this injurious system of street cleaning which ruins pavements of all kinds, fills sewers with street dirt, consumes an excessive portion of water supply and is otherwise not economical.

A recent test of cleaning by high pressure flushing system in New York City shows, as reported: (a) cost 72 cts. per 1,000 sq. yards. per cleaning, for labor and water; (b) 2 gals. water consumed per sq. yd. of pavement cleaned; (c) cost of water, 9 cts. per 1,000 gals.

At this rate in a city having 200 miles, say 4,000,000 sq. yds. of pavement, cleaned daily (Sundays excepted), say 300 times per year, the cost would be $2,880 per day, or $864,000 per year.

The water consumption figures 8,000,000 gals. per day, at 9 cts. per 1,000 gals. equals $720 per day, or $216,000 per year, or approximately the cost of water supply of a city of 50,000 population. Knowing that the water used in flushing carries to the sewers at least 10 per cent. of its bulk of street dirt and a large portion of the dirt settles in the sewers, we see the great additional cost of sewer cleaning.

Every engineer, or official, and every periodical which is interested in construction and maintenance of street pavements, should persistently and at all possible times and places raise their voices in loud acclamation against this system of "pavement ruination."

On this subject I quote the following from the St. Louis Daily News of May 20th:

"Present Method of Flushing the City's Streets Detrimental to Their Proper Maintenance—Volume of Water Employed is Excessive—Unnecessary Expense to Tax Payer.

"From more than one source have lately reached the Daily News complaints, which would seem to be justified, with regard to the system of flushing the city's streets.

"No one can have failed to notice the tremendous force with which the water is projected from the flushing machine employed in cleaning our streets, a force sufficient to drive the sand and soil from between the interstices of the granite blocks with which some of the streets are paved and to work serious damage to those of artificially constructed asphalt or bituminous surface. The result has been that repairs to the streets become necessary much more frequently than is at all necessary or than would be the case if a more natural system of cleaning were employed.

"Nor is this all. The volume of water consumed in street cleaning operations at the present time is excessive; and is also a source of unnecessary expense to the long-suffering taxpayer. So great indeed is the flow of water sewerwards down the gutters when the "flushers" are at work that few can get off the sidewalk without wading. With this

stream goes not only all the street refuse but also much of the paving materials.

"During the past year the Street Department has curtailed the use of flushing machines and the improvement in the condition of the pavements is marked.

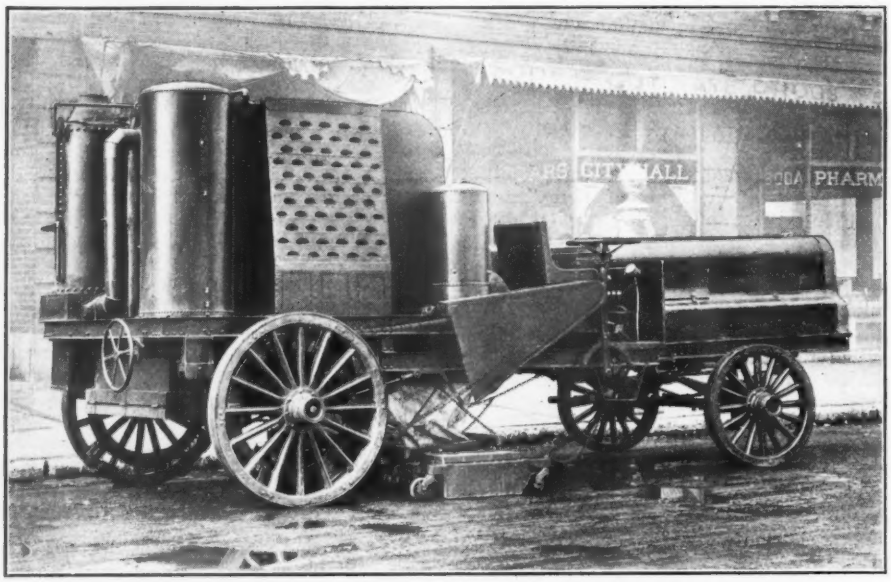
"Interviewed by a News reporter the Street Commissioner, Mr. Travilla, admitted that these flushing machines now in use, if employed too frequently, damage asphalt or bituminous paving. The damage to brick, granite and wood pavements is also great, causing the joints to be opened, the pavements to be loosened and steadily dislocated, uneven and need excessive repairs.

"Constant patrol hand sweeping, with occasional machine sweeping and light sprinkling just before sweeping, to allay dust, has been demonstrated to be the most economical, satisfactory and efficient method not only for preserving pavements but especially for keeping streets constantly clean at all times of day."

The squeegee is another type of machine which has recently come into use. It uses a smaller amount of water than the flushing machine, and depends for the cleaning action on a soft rubber spiral mounted on a revolving roller. On a perfectly smooth asphalt surace it produces good results, though the amount of water used is such that much of the dirt finds its way to the sewer. It necessarily fills all depressions level full of dirt, and cannot be used over street car tracks.

Hand scraping is effective as far as removing the heavier dirt is concerned, and as an auxiliary means for cleaning streets subject to heavy traffic has without doubt a permanent place.

Pneumatic cleaning bears the same relation to street sweeping that vacuum cleaning does to broom sweeping for floors. It is dustless, and the street which has been swept is dustless. It removes all the dirt, the fine light dust as well as the heavy, not only from the surface, but also from all the cracks, the spaces between bricks and granite blocks, and from street car tracks. A rough pavement is cleaned as thoroughly as the smoothest asphalt surface. No sprinkling is required; there is no possibility of damaging any kind of pavement. The passing of the sweeping gang ceases to be a nuisance to the residents.



FURNAS AUTOMOBILE AUTOMATIC STREET SWEEPER.

These results are accomplished by the Furnas pneumatic street cleaning machine.

The picture shows a general view of the machine, which is of the automobile type, propelled by a gasoline engine.

The sweeping hood is shown resting on the street. This is preceded by a set of coarse brushes or rather scratchers, which loosen any dirt which may be stuck to the street surface.

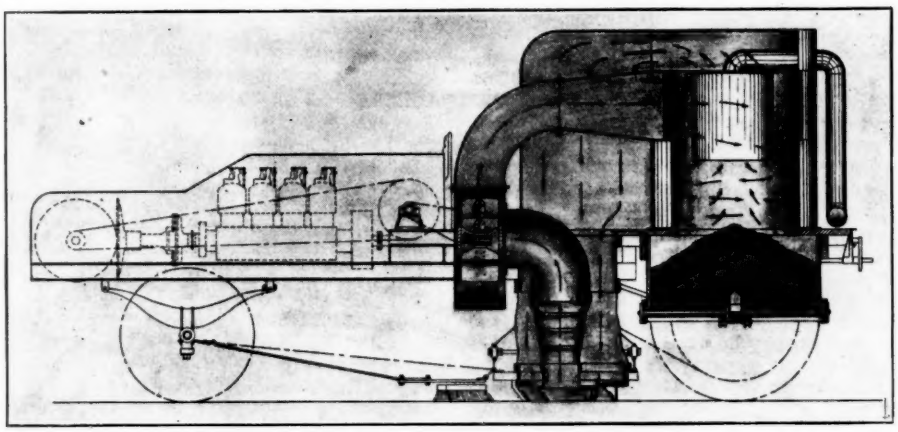
The dirt is taken up and deposited in the dirt box, the bottom of which consists of two doors which can be dropped for depositing the load.

The small boiler shown, furnishes a supply of steam which dampens the dirt, aiding in its separation from the air, and also forms it into a dustless mat or cake

in the box, so that no dust is made when dumping, or when loading into wagons.

The sectional view shows the air circulating system, which is the interesting and all important part of the machine. The general plan is that the air used for sweeping is recirculated, being used over and over again, with the exception of a small amount which is taken out to provide for leakage as will be explained later.

You will notice that the sweeping hood consists of an inner and an outer portion. The outer portion is enclosed by short curtains, or lines, made of canvas, to which small plates of iron are riveted. These plates serve to weight down the canvas and also to take the wear, due to dragging on the street. They are sufficiently light, however, to pass over the dirt, and not act as a brush or scraper.



SECTIONAL VIEW—FURNAS STREET SWEEPER.

The inner portion is separated from the outer portion on the front side by a similar line, but on the rear side by a metal strip which runs at a distance of about one-half inch from the street surface. This is the real sweeping point. The air comes down in the outer portion at a comparatively low velocity and at substantially atmospheric pressure.

The inner portion is under the full suction of the fan. The air rushing through this narrow opening at high velocity, and in a direction practically parallel with the street picks up the dirt, which is then carried up through the opening in the center of the inner portion.

As shown this opening is connected directly to the fan suction.

From the fan the air and dirt enter the centrifugal separator, which is directly above the dirt box. Here a small amount of steam is blown in as previously described. After the air has deposited the dirt picked up from the street it leaves by the center tube and returns directly to the outer portion of the hood. Within the center tube by which the air leaves the separator is a small pipe, which is open at the lower end. A small amount of the air leaves by this pipe, which leads to the ash pit of the boiler. The amount of air taken out through this pipe is equal to the inward leakage to the outer portion of the hood.

The pressure in the separator, and hence the amount of air leaving by the small pipe, is controlled by the damper shown in the passage between the separator and the hood. Indirectly this determines the pressure in the outer portion of the hood, which is maintained at or slightly below that of the atmosphere, so that any leakage is inward, thus preventing dust.

The small steam boiler serves a double purpose. Steam added to the dirt and air as it enters the separator, increases the weight of the dust particles and thus aids in the separation. It also dampens the mass of dirt so that dust is prevented when dumping. The air returning to the hood, and therefore the air leaving the separator by the small off-take pipe carries a fine dust which it is very difficult to separate. The fire in the boiler serves as an effective filter for removing this from the small volume of air which must be discharged, while the air acts to produce draft for the fire.

The power equipment consists of a 6 x 6 four-cylinder engine, located at the forward end of the machine. The sweeping fan is driven from the rear end of the engine shaft through a cone clutch and spur gears running in oil. The

power for propulsion is taken from the front end of the shaft and transmitted through a friction drive and differential jack shaft to the rear wheels. The maximum speed of travel is 5½ miles per hour, which may be reduced by the friction transmission, as required by the condition of the street being swept.

The machine is operated by two men. The driver controls the steering, and propulsion and fan speeds. The operator controls the pressures in the air system, raises and lowers the hood as required by means of the two levers shown, fires the boiler, and dumps the dirt.

For average conditions this machine will sweep 15 to 18 great squares of 10,000 sq. ft. per hour.

Management of Water Plants in the Smaller Cities.*

By E. L. Loomis, Superintendent Home Water Co., Valparaiso, Ind.

THE first and foremost duty of a waterworks enterprise is to supply its patrons abundantly and constantly with a good, clear, clean and wholesome water. How well or how poorly that duty is performed rests solely with the management of such an enterprise. Most of our larger cities are now meeting these public requirements fairly and squarely, and while it is true that many of our smaler cities are providing such a satisfactory quality of water to their patrons, it is likewise true that there are many others which are not doing so.

Good water is one of the prime necessities of human life, and to serve it meagerly where an abundant supply is obtainable, or to serve an unfit and impure quality, should be no longer tolerable by an intelligent community, nor should it be considered good business management on the part of the enterprise. Each succeeding year as we note the ever-increasing pollution of our streams and public water supplies, the demand is proportionately, and very properly, becoming more and more insistent for a better water. And with these changing conditions, so great has been the advancement in sanitary engineering that with modern methods of filtration, the vilest supplies, even though thick with mud, foul of smell and laden with the germs of disease, may be so purified as to become entirely potable and safe for human use.

In former days it was supposed that only the larger cities could afford up-to-date water plants with their splendid filtration systems such as we have all been privileged to examine here in Indianapolis, and while it is still true that our smaller cities cannot afford such extraordinary equipment, yet none are so poor but they can well afford to dispense at least a good safe water. For us in this age to be satisfied to serve our patrons an impure and inferior product is at once to acknowledge our own delinquency in the highest offiicial duty with which we are charged. Whether the plant be municipally or privately owned does not matter. The standard of quality should be placed just as high in the one case as in the other. Nor should there be any doubt existing in our minds as to what the standard of purity should be. The time for hap-hazard suppositions or guess-work has long since passed by. Every waterworks man should really know his product, and in order to do so, wherever possible, he should install his own laboratory equipment for making the necessary tests. But in cases where this may not be done, nearby laboratory assistance could doubtless be easily obtained; or the state if called upon is always willing not only to furnish analyses but to give valuable expert assistance and counsel at any time, to the end that the healthfulness of the people of the state residing within the borders of our municipalities may be be properly safeguarded and conserved.

Water which is merely good enough for fire protection, manufacturing purposes and lawn sprinkling in our smaller cities is, and should be, no longer regarded as satisfactory. Any city, however small, if it is large enough for a waterworks system at all, is large enough to afford, and can afford a water of good quality for its citizens. The demand of the times as related to all human sustenances, to water supplies as well as to food supplies, is for a higher standard of purity—the best which nature and science can produce.

Therefore, in the judgment of the writer, with such a demand existing on the part of the public, it is not only bad management but may we not say the grossest sort of mismanagement for any municipality or company to furnish its consumers with any kind of water but good water. Though actuated by no higher motive than purely selfish busi-

*A paper before the Indiana Sanitary and Water Supply Association.

ness policy it is still the best evidence of good management, even in our smaller cities, when a high-grade water is produced.

In the discussion of this topic the writer has dwelt upon the quality of water supplies for the reason that more especially in our smaller cities this fundamental consideration in the management of waterworks utilities is all-too-frequently disregarded, whereas it should be of paramount importance both to the enterprise itself and the public which it serves.

Wherever water exists at all it is possible to make it good, and that, too, at a price easily within the reach of all. The public wants the best, and as a general rule is willing to pay the necessary price for it, notwithstanding the fact that some neighboring city may charge a somewhat lower rate for a poorer water. The old, time-worn antedated theory that all cities of about the same size should pay about the same rate for water, no matter how different the cost of production or how dissimilar the service, thanks to the growing intelligence of our times, has about run its course. Such a theory was discarded by the larger cities years ago, and there is no surer indication of progress on the part of our smaller cities than when observed following their good example in this regard. Next to furnishing a good water, it is the highest mark of good management when the rate for water is made to depend upon the cost of the finished product, without regard in any way whatever to the rates in vogue in any other city, whether higher or lower. No fact is better recognized or more firmly established among the fraternity than that rates are comparable only so long as conditions in the different cities are comparable. It is likewise recognized that no two cities have precisely the same conditions to meet. Hence the utter impossibility of exactly similar rates.

Thus, having first of all, produced a good water and having established a fair rate of charge for the same, the management of an enterprise of this character has taken upon itself responsibilities and duties that are legion. Not merely must a clear, wholesome and sparkling water be produced but the service must be up to the standard in every particular. The pressure must be as constant and unvarying as is possible to give. In case of fire, the equipment must be in such condition as will permit it to be instantly brought into action for its highest and most efficient duty.

If a manager must know his product, so must he also know his plant, its capacity for constant service, its durability under intense strain, and the proper economy with which it should be operated, not only as related to fuel supplies and attendance, but economy in conserving the output as well, the accomplishment of all of which will be found to tax to the limit all the watchfulness and skill of which the most active manager is capable.

If flat rates should be in vogue a frequent inspection of all fixtures in any way connected with the system is necessary in order to keep the waste and leakage reduced to the minimum. Water closets will get out of order. Urinals will become opened too full. Faucets will be turned on to prevent freezing, as doubtless most managers have been brought to realize during the unusually severe cold weather of the past few weeks. Rigid rules to conserve the supply, and a rigid enforcement of them are indispensable and imperative necessities as against those who willfully abuse the flat-rate privilege. Wherever such conditions of wastefulness prevail the department should very promptly enforce meterage or shut off the supply. Indeed, meterage to begin with, is the only fair or equitable way to sell water; and as we approach the entirely metered system just so much nearer do we come to the ideal toward which all our cities, large and small alike, should constantly strive.

But even water meters are sometimes prone to err. They, also, need attention from time to time as well as leaky fixtures or wasteful patrons. Every meter in service should be zealously looked after from month to month to note any unusual variations in readings. Frequent tests should be made to verify their correctness. As meters almost invariably register in favor of the consumers when incorrect such watchfulness will be found to result in largely increased returns to the water department or company, as the case may be. Records of all tests and repairs should be made and conveniently filed for reference.

Because a waterworks plant is small is no adequate reason for laxity in its system of records and accounting. Indeed, all the greater should be the necessity for accurate, convenient, systematic and comprehensive records. Good bookkeeping and well-kept records are absolute necessities to the successful conduct of any enterprise no matter how small or large it may be. Even in the smallest water-works plant such a system should be employed as will disclose at any time the actual working conditions of the business. Moreover, it should be in such form that comparisons may readily be made with any corresponding period in the history of the enterprise. To the alert and wide-awake manager such comparisons are fraught with many enlightening suggestions which he will find to be valuable aids in the prosecution of his work. For instance,

in the purchase of coal, a comparison of the results obtained from the different grades will disclose which is best and most economical to use. A comparison from day to day of pumpage records, laboratory test records, coal consumption records, recording pressure gauge records and watchmen's clock-dial records will all be found to be abundantly worth while. Likewise, a comparison from month to month of receipts and disbursements, when properly classified, will tend to emphasize conditions needing correction, and by so pointing out the way to the right sort of management as the business develops and grows, will make failure improbable and some degree of success, at least, not too difficult to be realized.

The office records should show completely of what the physical plant consists. Every water main should be definitely shown as to location, connection and size. Every valve, fire hydrant, curb stopbox and service pipe should be correctly mapped, and each service record made to fully indicate every fixture and purpose for which it is to be used by the consumer. These really important matters too many of our smaller cities entirely disregard.

Good accounting will not permit the capital investment account to be charged with replacements and repairs, nor will it attempt to deceive by failing to take into consideration the very important item of depreciation.

Thus may we not safely conclude that, with good water, fair rates, a proper public demand, good operating equipment for the service required and a good system of accounting, all that can remain essential to make the concern a success are the right men on the job. And of these at least a passing word is here thought to be well worth while.

It is observed that the larger cities and water companies which have achieved the greatest success in our field of operation have and keep in their employ the very best help they can obtain. They are in constant touch with every phase of water works development in other cities. And although the heads of these larger enterprises are high-class, capable men, whenever difficult problems arise, either in construction work or management, they are quick to avail themselves of the help of eminent professional water works men upon whose aid they know they may safely rely.

With our smaller cities, however, as a rule such a progressive tendency is not so marked. Too frequently does it occur that as managers we are found lacking in a full appreciation of the importance of the work devolving upon us to perform. The manager of a water works plant, however small, has in his care many thousands of dollars of invested capital represented by the physical value of the plant. To properly care for the same and to obtain therefrom the highest economy, efficiency and returns, he should avail himself of every aid in his power to obtain. The best trade journals should come regularly to his desk. Conventions of water works men should be attended and every available opportunity should be taken advantage of in order to learn what others are doing and to keep in constant touch with the advancing progress of the times. And if those of larger capacity and a much wider range of experience than we could possibly possess require the assistance of expert knowledge in their work occasionally, how much greater is our need for help from time to time when important problems in our own work must be met and solved.

Indifference on the part of a manager as to what others are doing will, in nine cases out of ten, result in the stamp of failure being placed upon his work. If we would make our business a going-concern, therefore, it is imperative that we should bring to our aid as much of the kuowledge and experience acquired by other companies and other cities as possible, and this the progressive manager will not be slow to do.

Another thing the right sort of manager will do: No matter how heavy his own burdens, or how great the provocation, he will bear in mind in dealing with the public that, "a soft word often turneth away wrath," and also that a smile once in a while will cost him nothing at all. Courtesy and consideration toward the public, as well as patience under unwarranted criticism, in the long run he will find always to pay. And if we deal courteously with the public, what shall we say of our help, upon whose everyday loyalty and untiring efforts much of our success must of necessity largely depend. Every helper in the enterprise, from the highest to the lowest, should be made to feel that he is a valued partner in the business, in spirit at least. Having once obtained good, loyal help the most cordial and mutually helpful relations should be maintained. Frequent changes of help not only look bad for the management, but detract from the highest state of efficiency in the service as well. One of the most baneful influences of municipal ownership of our utilities is the tendency to repay political obligations with these positions without proper regard to the qualification and fitness of appointees, sometimes changing the entire force with each successive administrative change in the city's political affairs. Under such conditions any substantial progress is almost beyond the realm of human probability.

No department of public work has de-

volving upon it larger and more far-reaching responsibilities toward the public than the water department, the correct and successful handling of which requires years of constant study and the most untiring devotion to duty that is possible for any man to give. Without good men to direct and without loyal co-operative help on the part of employes, even the best of physical plants must fail. Ultimate and lasting success cannot be achieved in a day or a year. If it comes at all it must be to those who by their work are able to prove their worth. Intelligent supervision and the most diligent application to the multitude of details and duties which daily arise constitute the price of success in the water works business just as in any other enterprise. In all our cities, whether large or small, there is no better or worthier work to be performed than to supply our fellow-beings with good water, and in doing this, if we are able and willing to pay the price of success in our work, we surely cannot entirely fail.

Bituminous Concrete Pavements in Washington, D. C.*

By Captain Mark Brooke.

IN the search for a satisfactory solution of the problems which have arisen since the introduction of the automobile, road engineers seem to be working toward a definite type of pavement, bituminous macadam. In this, history is repeating itself, for many of you in your attendance on this convention will have ridden over a pavement of the same type, the bituminous concrete, laid forty years ago, in response to the demand for a better type of pavement than the rough block and cobble then existing. The highway engineer of today should, therefore, find something of interest, possibly of practical value, in a brief history of Washington's bituminous concrete pavements.

Washington today has 3,000,000 sq. yds. of bituminous pavement, other than asphalt block, of which 1,200,000 sq. yds. are are cement concrete base, and 800,000 sq. yds. on a base of bituminous concrete. Of this amount 600,000 sq. yds. have, at some time, been resurfaced with asphalt over the original pavement, and less than 200,000 sq. yds. of old tar and tar-asphalt pavements exist as originally laid.

In point of time the history of these pavements may be divided into three distinct periods, in each of which a different class of pavements was laid.

The first period is that from 1871 to 1878, the period of the old patented types, to which the designation "concrete" has been applied locally. The second period was from 1888 to 1893, when a type of bituminous base pavement known here as "coal-tar distillate" was laid, and the third is embraced in the last two years, during which time a limited amount of bituminous macadam has been put down.

In attacking the task of paving the streets of this city, which had been cut to pieces by the supply teams of the army during the Civil War, the city authorities sought for a smoother type than the cobble with which the city was partially paved, and Washington for a number of years was a fertile field for inventors of wood block and bituminous pavements. Between 1870 and 1875 about 700,000 sq. yds. of bituminous base paveemnts were laid under various patents, among which were the Evans, the Filbert or Vulcanite, the Scharf, Abbot, Bailey and Parisen.

While differing in detail they were generally similar in character, and in all of them the attempt was made to get a pavement in which a more or less accurately graded aggregate should be bonded with a bituminous cement into a dense concrete.

The method in which this object was sought to be obtained in the different pavements is interesting, and I will give a resume of the specifications of several of them.

The Bailey pavement consisted of a foundation about 1 ft. in depth of stone from 2 to 10 in. in size, into which was poured a cement composed of a mixture of asphalt fluxed with tar, ground slate, soapstone, pulverized dry clay, shells and stones. Upon this foundation was spread a 2½-in. course of ½ to 1½-in. stone, over which was poured a mixture of hot tar, asphalt and oil of pitch. On this second course was laid a third, 1½ in. in depth, composed of fine gravel, coarse and sifted coal ashes mixed with the tar of asphalt cement. All these layers were then rolled with a heavy roller.

The Parisen pavement, of which about 70,000 sq. yds. were laid between 1872 and 1875, was constructed as follows: A base course of 2 to 4-in. stone thoroughly mixed with coal tar, lake asphalt, fine screened gravel and calcined gypsum was laid to a depth of 6 to 8 in. and rolled. In the voids in the surface of this course was rolled a light course of stone chips or

*A paper before the American Association for the Advancement of Science.

gravel mixed with medium tar and Portland cement. The surface was then painted with a coat of the cement used in the base. On top of this was a 2-in. course of gravel, gypsum and Portland cement mixed with bitumen in the proportion of ¾ medium distilled coal tar, ⅛ mined Cuban asphalt and ⅛ "dipped" or Trinidad asphalt. After rolling this course, it was painted and the last course was repeated. The object of the paint coat, it was stated, was to serve as a seal and to form a bond between the adjacent courses, and the inventor claimed as one of the advantages of this pavement that the base courses were firmly bound and the spaces filled and solid.

The Scharf pavement, of which about 200,000 sq. yds. were laid, consisted of three courses, a base course of 4 to 7 in. deep, composed of a mixture of stone and stiff bitumen obtained from the slow distillation of coal tar; then a 2-in. course of stone mixed with a cement of 1 gal. of pitch to ½ lb. of asphalt; and a wearing surface of small stones and gravel, hydrated lime, cement, pitch and asphalt.

The Vulcanite or Filbert was the simplest in construction and proved the most lasting of all the patented pavements. It was composed of a mixture of 80 lbs. of asphalt, 30 lb. of either rosin, pitch coal tar or pine tar; 5 lb. of sulphuric acid, 90 lb. of lime, and 600 lb. of sand, fine gravel, ground iron cinder and broken stone. The sand and aggregate were first mixed and dried, and then the other ingredients added, and the mixture heated to a suitable consistency. The hot mixture was then spread upon the sub-grade and rolled. The proportion of cement in this mixture, approximately 14 per cent., is slightly greater than the percentage of asphaltic cement in our own present standard top mixture.

The foregoing descriptions have been taken from the specifications in the patents as recorded in the Patent Office, but I believe that they should be taken as descriptive of a theory rather than a condition, as they probably do not accurately describe the pavements as actually laid in many cases. The specifications themselves, it will be noted, are generally vague as to sizes of aggregate and proportions, leaving considerable to the discretion of the contractor doing the work. Those specimens of the different pavements which have been preserved could scarcely be identified by the patent descriptions, and different samples of the same pavement show marked dissimilarity. They all possess one common characteristic, small proportion of voids.

The cost of these pavements varied from $1.74 to $3.70 per square yard. Many of them proved unreliable and had to be resurfaced within a few years. The trouble appears to have been in the wearing course, for whenever a new asphalt or Vulcanite surface has been laid on the old pavement it has stood many more years of service.

Of the 190,000 sq. yds. of Evans pavement, laid for the larger part in 1873, nearly the entire amount was resurfaced within two years. Two-thirds of the Parisen pavement was resurfaced within five years and the remainder within the next three.

Part of these pavements were resurfaced with asphalt and a portion with the Vulcanite pavement. The Scharf and Vulcanite proved much more durable, and many of them have been refurfaced or replaced only in the last few years in which they have been in service.

The experience with bituminous concrete as a whole was so unsatisfactory that when the first board of commissioners was established in 1878 it expressed its intention of abandoning this class of pavement in the following terms:

"In determining the class of pavements to be laid the commissioners maintain that each class of pavement must prove its qualities under the test of actual traffic before being extensively laid upon the streets of this city.

"While some of the later and better class of coal-tar pavements show good surfaces and give fair promise of a reasonable durability, yet the general condition of this class of pavement in the city is such as to lead to their condemnation as faulty in principle and deficient in vitality. The use of bituminous bases has also given rise to many perplexing problems in the grades of streets upon which they have been used, and as, when properly laid, their cost is as great, if not greater, than the hydraulic concrete, they have been definitely abandoned."

From that time on sheet asphalt on a 6-in. hydraulic cement base has been the standard pavement of this city, and no more bituminous concrete was laid for a period of nine years.

The opinion thus expressed seems to have been modified in the succeeding years, for the report of the engineer department for 1887, after quoting the report of 1878, goes on to say:

"In the meantime, however, a period of nine years has elapsed and the well-preserved condition of some of the later and better class of coal-tar pavements has led many to believe that the faults of the earlier pavements are not irremediable and that with proper care such pavements can be laid nearly equal to the asphalt in most respects, and superior in the quality of economy of first cost as well as in some other minor particulars."

The annual expenditure for maintenance of the bituminous concrete for the 15 years ending July 1, 1886, was 5½ cents per square yard. For the first five years the average cost was 3.7 cents; for the second five years 6 cents, and for the last five years 6.6 cents.

The 100,000 sq. yds. of Vulcanite, which at that time had been down 14 years, averaged only 2.9 cents per yard per year during that period, about the cost to-day of maintaining our standard pavement.

It is not probable, however, that there would have been a return to the bituminous type had it not been for the action of Congress in virtually compelling the abandonment of the hydraulic base pavement.

The paving appropriation act of 1886 contained a clause to the effect that no contract should be made for laying concrete or asphalt pavement at a higher price than $2.00 per yard for a quality equal to the best previously laid. Bids were then taken on a pavement with a 4-in. natural cement base and some laid at the $2 price. The following year Congress stipulated that the cost should not be higher than $2 for a quality equal to the best laid prior to July 1, 1886, and with the same depth of base. This condition, with varying limitations, has been retained in every appropriation act to this day. This meant that asphalt could not be laid on less than a 6-in. base, and as bids could not be obtained for this pavement at $2, recourse was had to a bituminous concrete, and during the next five years 425,000 sq. yds. of such pavement were laid.

This pavement, laid under District specifications, was of two kinds, known locally as the "coal-tar distillate" and the "combination."

Both pavements were 7 in. in depth and consisted of 5½ in. of base and binder and 1½ in. of wearing surface, the difference being in the character of the top course.

The base consisted of stone passing a 3-in. ring, rolled to a depth of 4 in. and then coated with a No. 4½ coal tar paving cement, 1 gal. to the yard.

The binder course was composed of screened stone not larger than 1¼ in. and No. 4 coal tar cement. The stone for this course was heated, mixed with the cement in the proportion of 1 gal. of cement to a cubic foot of stone, then spread on the base to a depth of 2 in. and then rolled.

The wearing surface of the "distillate" pavement was composed of about 60 per cent. sharp sand, 25 per cent. screenings, 14 per cent. paving cement and small quantities of hydraulic cement, slaked lime and sulphur. The cement consisted of about 30 per cent. asphalt to 70 per cent. No. 4 coal tar.

The surface of the "combination" pavement consisted of the standard asphalt top mixture laid on the tar base and binder courses just described.

These pavements continued to be laid until 1893, when they were abandoned for the hydraulic base pavement, the cost of which had come within the $2 limitation fixed by Congress.

Since 1908 we have resumed laying bituminous concrete in the form of a limited amount of bituminous macadam. This pavement, however, belongs to the present, it is not a matter of history and its description does not properly fall within the scope of this paper.

While both the "distillate" and concrete pavements are of the same general type, the difference in construction and quality is very marked.

The pavements of the period from 1871 to 1878, which run in depth all the way from 8 to 14 in., are a dense, tough concrete in which the stone is thoroughly coated, and the voids, small as they are, completely filled with a tar which appears as bright and fresh as though just laid. The distillate pavements, on the other hand, which have a uniform depth of 7 in., are brittle, the base course deficient in tar and, such as there is, inert and lusterless. The difference in the quality of toughness will be appreciated from the fact that in our resurfacing contracts we have different prices for the removal of bituminous pavements of the class laid before and that laid after 1880, paying $1.85 per cubic yard for the removal of the former and $1 for the latter. The older pavements are much more homogeneous in character, and even in those that were laid in successive courses there is no well-defined line of demarcation between the successive layers. However, the large quantity of cement, in some cases as much as 4 gal. to the square yard, used in the old pavements made them objectionable, wavy and in more than one instance, on a grade, they have been known to flow over the top of the curb.

The theory of these pavements was that they would form an indestructible base for a wearing surface which would be renewed as occasion demanded, and many of them, particularly of the distillate class, were laid with very flat sections, with a view to crowning, which was anticipated as the result of successive resurfacings.

As a matter of fact it proved impracticable to resurface them properly, as the old surface did not wear away uniformly, and it was impossible to strip it from the base, so intimately bonded were the two courses. Moreover, the street engineering of those days was rather crude, and

many faulty grades were established. In a number of cases the surface deterioration was undoubtedly partially due to the poor drainage resulting from insufficient crown. It is rather from the necessity of correcting these conditions than from any other inherent defects of the pavements themselves that they are being replaced instead of being resurfaced.

The average age of all the street pavements resurfaced in Washington last year was slightly over 25 years, and it is safe to say that the old bituminous concrete averaged over 30 years.

There are not many of the old pavements left to-day. The Vulcanite pavement on De Sales street, laid in 1875, has never been resurfaced. The south side of Pennsylvania avenue, N. W., from Eighteenth to Twenty-first street, is a Scharf pavement laid in 1875 and resurfaced in 1887 with a tar distillate top. F street, in front of the Willard Hotel, is a Scharf pavement laid in 1873 and resurfaced in 1878 with an asphalt top. The Scharf pavement on Vermont avenue, in front of the Arlington Hotel, than which there was no better pavement in this city until gas recently got into it, was laid in 1871, and resurfaced in 1878 with an asphalt top over the original pavement.

Whatever may have been the faults of our bituminous concrete pavements viewed in the light of our greater knowledge and experience, they have served their purpose well and early formed a standard which made Washington the best paved city in the country. At one period of this city's history there were over 1,000,000 sq. yds. of this pavement, and to-day, either in original forms or as the basis of a later pavement, they form over 25 per cent. of our smooth pavements.

A detailed history of these pavements would doubtless give us many valuable suggestions. I am going to refer to but three which have impressed me, and they are, that the mixing method is better than the penetration, that the more homogeneous a pavement is and the fewer courses in it the better, and that nature and modern process patentees are not unique in their abhorrence of a void.

Notable Work on the Catskill Aqueduct.

THE construction work going on in connection with the carrying out of the Catskill Queduct project is deservedly attracting widespread attention. It is inevitable that important problems have to be solved when it is proposed to bring an enormous supply of water from a mountain district one hundred miles distant, conducting it across a score of valleys, some of them several miles in width, as well as across so deep and broad a river as the Hudson. The problems have especial interest for the municipal engineer because of the very character of the enterprise. They have large interest for the concrete engineer for the reason that the construction of the aqueduct is everywhere involving the use of Portland cement and concrete. The steel siphon work should have the earnest attention of the engineer and manufacturer concerned in the possibilities of steel construction. The mining engineer has his interest claimed by the shaft and tunnel construction. Portland cement (in cement mortar or in concrete) plays a most important part in all of this. It is not only involved in the concrete of the cut-and-cover sections, but it is relied on to make possible a protective covering for the inside and the outside of the steel siphons. It has been found of exceedingly great value in the sinking of one of the deep working shafts; in fact, it may be questioned whether the sinking of this shaft would not have failed without it. Consider then the Rondout pressure tunnel and the steel siphons.

THE RONDOUT PRESSURE TUNNEL.

The Catskill Aqueduct may be said, if one speaks broadly, to parallel the Hudson river. Consequently, the route cuts across the tributary streams. These are creeks, or brooks of no special importance, so far as size goes. However, they mark the positions of valleys, some of which are a number of miles in width. One of the largest is the valley of Rondout creek. In making the crossing at this point, the aqueduct drops far below the surface of the ground, far below the bottom of the creek, and thus makes the 4½-mile passage from one side to the other. A vertical shaft at each end, and a third located at an intermediate point will remain permanent features. In addition, five other shafts were sunk to the tunnel grade in order to facilitate construction. One of these, Construction Shaft No. 4, is 500 feet deep. It is 10 x 22 feet in

horizontal section. Eighteen months were occupied in putting down this shaft. It was flooded six times. The strata passed were:

Glacial drift	6 feet
Helderberg limestone	226 feet
Binnewater sandstone	39 feet
High Falls shale	92 feet
Shawangunk grit	134 feet
Total	497 feet

The trouble with the water came, no doubt, almost altogether from the sandstone and the shale. But the water made its presence felt long before these strata were reached. The site of the shaft included the location where a 4-inch test hole had been put down. When a depth of about 80 feet had been reached, a sud-

CASTKILL AQUEDUCT. STEEL PRESSURE SIPHON.
Concrete Cradles in Foreground.

den inrush occurred through this hole, filling the shaft half full. The emergency pumping plant had not yet been delivered; so that the contractors were caught unprepared. However, by the use of an air-lift and a couple of sinking pumps, the water level was lowered to a point near the bottom. A nipple was driven into the hole and casing attached to it. The purpose was to grout up the hole. In order to carry out this plan a 1-inch pipe was put down to the level of the Shawangunk grit —that is to the 363-foot level. The water was now permitted to return. Pressures were thus equalized and currents prevented. The grout was made according to the formula 1:1, and poured down the 1-inch pipe. This latter was withdrawn as the grout filled in.

The problem of this one hole was solved in this way. But fears began to be entertained as to whether the ordinary methods of shaft sinking would prove successful. It was understood that there was below a great deal of water under considerable pressure. With subsequent events in mind, it is not difficult to see that a special pumping chamber in the side of the shaft should have been provided before permitting the excavation to pass out of the limestone. This arrangement was made later, but the delay was the source of much trouble. However, excavation went on, and the sandstone was penetrated. At the 260-foot level, the amount of incoming water was only about 225 gallons per minute. However, during the drilling of the sump, an additional 600-gallons per minute came in suddenly through one of the drill holes, with the result that the shaft was flooded again. After some trouble, the shaft was unwatered, only to be flooded three additional times in as many weeks. Pretty much all this water came in through bore holes, none of which was probably over two inches in diameter. When the fifth unwatering had been completed, the conditions below were known to forbid further progress apart from special precautions. In fact, it had been ascertained that large crevices were a short distance beneath the bottom of the excavation. One of the largest of these crevices ran up to 8 inches. As compared with the 2-inch bore holes, they promised plenty of trouble.

It was now proposed to deal with the water question by means of grout. Four special machines were set up at the mouth of the shaft. A 2½-inch pipe led down the shaft to the bottom, where a 2-inch hose carried the grout to the point of use. At the beginning of operations, the grout gave trouble by leaking back. It would come in through the spaces around the pipes and through cracks in the bottom. This difficulty was successfully met by mixing finely ground horse manure with the grout. The manure produced a clogging effect. Somt grout was wasted, but success was eventually obtained. In this procedure, a total of 2,900 bags of Portland cement was consumed. When the grout had hardened in the crevices, a few more holes were drilled. Water having a head of 65 pounds was found 14 feet below. These holes were soon grouted up, only 60 bags of cement being required.

But sinking was not at once resumed. It was deemed advisable to deal further

with the question of the water. The grit was now about 100 feet further down. It was proposed to grout up the intervening water-bearing strata with more grout. Accordingly, six diamond drill holes were put down to the grit. Half were of the size corresponding to a 1-inch core; and half to a 2-inch core. With a pressure of 275 pounds per square inch, these holes were grouted up with 175 bags of cement. Nobody knew whether this small quantity of cement meant that the problem was a small one or whether it had been only partially solved. It would seem that the thorough application of the method of grouting ahead of the excavation should have been employed sooner—that is, before the water bearing strata had been penetrated.

Sinking was now begun again, and prosecuted until a depth of 320 feet was reached. A couple of collecting rings had been arranged, and many sinking pumps installed in the shaft. The working space was much impeded. Besides it was difficult to secure easy, certain and adequate pumping capacity by the use of sinking pumps alone. It was determined to construct a pumping chamber off to one side at the 309-foot level. This chamber was quite large being 10 feet high and having horizontal dimensions of 17 and 24 feet.

Beneath its floor a sump 5½ feet deep and 16 x 22 feet in area was arranged. It had a capacity of 14,500 gallons. In the special chamber were installed three Cameron horizontal condensing pumps. These were all the 24 x 10 x 20-inch size and had a combined capacity of 1,050 gallons per minute. They were run by the steam supplied by three 100-h. p. boilers set up at the mouth of the shaft. As the pumps were of the condensing type, this whole arrangement was a possible one. Before the installation of this powerful pumping plant, the sixth flooding of the shaft took place. Subsequently no especial difficulty was encountered from the water. More grouting was done, but none of the seams required more than 100 bags of cement, with one exception. When the grit was reached, a hole gave trouble and required 348 bags of cement. The amount of water pumped from this one shaft was 86,181,000,000 foot-gallons. The total amount of Portland cement consumed in the grouting operations was 971 barrels.

THE STEEL SIPHONS.

Where the Catskill Aqueduct crosses a very broad valley, a permanent vertical shaft is put down on each side and the two bottoms are connected by a more or less horizontal tunnel through the solid rock. But where the valleys are quite narrow, the practice is to make the crossings by means of steel tubes. These are of enormous dimensions. Three parallel tubes are required for each crossing in order to furnish full capacity. Only one is being put in at present—the middle one. There are to be in all fourteen steel siphon crossings of an average width of 0.455 mile. This work is divided into two contracts, one of which is held by the T. A. Gillespie Co., of New York City.

Altogether the fourteen siphons will require for the single central tube something over six miles of steel pipe. The diameters are 9.50, 9.75 and 11.25 feet. The thicknesses of the steel plate vary from 0.438 to 0.750 inch. The variations in diameter and thickness of plate are made in order to permit a standard capacity to be maintained under varying conditions and to enable varying bursting pressures to be withstood. The joints are riveted ones. Circular joints are lap riveted. With the thinnest plates (0.438 inch), the longitudinal seams are also lap riveted. For plates thicker than 0.500 inch the longitudinal seams are butt riveted. For the 0.500-inch thickness both methods are employed on longitudinal joints. The butt riveting is done by bringing the edges together—edge to edge—and then covering the joint inside and out with a steel strap. The inner strap is wider than the outer ones. The rivets securing the outer strap to the tube are also the central rows of rivets for the wide inner strap. They thus hold together three thicknesses of plate. In addition, two single rows of rivets are arranged in staggered positions relative to the two central rows. The two rows outside of all, which secure only two thicknesses of plate, have their rivets placed at double the interval used in the other rows.

In crossing the Peekskill valley over a mile and a quarter of pipe is required. All of it is of the smaller diameter. A short length (139 feet), presumably at the lowest point, is of the thickest plate (0.750 inch); then there is a total of 1,000 feet or more of the 0.688-inch thickness. Apparently no other of the crossings require such thick plate as the 0.750-inch thickness. This will be understood when it is stated that the maximum head at Peekskill is 340 feet—45 per cent. greater than in any other case. It is the widest and the deepest of the steel siphon crossings.

The steel pipe is furnished in 15-foot lengths. A circular joint has accordingly to be made every 15 feet. This fact has to be taken into account in the preparations for the reception of the giant tubes. Concrete cradles are arranged at such intervals as to permit the shop and field joints to come between them. The concrete cradles are 8 feet or more across—measured transversely the line of the aque-

duct; and about 3 feet wide. The same style is not used everywhere. A typical cradle has, however, a curved depression above to fit the pipe. It is then continued horizontally for a short distance, Underneath, a vertical section across the line of the aqueduct discloses a flat curve. The manner of casting is quite simple. Two bulkheads of the required form are placed on the earthen surface, which has been given the required curvature. The bulkheads are held temporarily in position by a couple of wooden strips nailed across. The concrete is poured in and the upper surface formed by hand. However, a transverse and several longitudinal grooves are described where cradle and pipe are to come into contact. These are provided by using short lengths of wooden strips. The object of these depressions will appear later.

When the cradles have been cast, the pipe suitably placed, and the field joints made, the entire siphon is filled with water, the pressure being brought to the conditions that are to exist when the aqueduct is in actual service. This is done not merely to test for possible leaks, but especially to give the pipe the exact form it will have when in actual use. While filled thus with water, the concrete envelope is put on. This is a proceeding requiring time. During this period, it is important that the pressure be maintained at the required point. It is necessary, therefore, not merely to pump the pipe full, but to maintain the pressure night and day. In this and other duties, the Cameron pumps have been engaged.

It is necessary or at least advisable to clean the surface of the pipe thoroughly preparatory to the application of the concrete envelope. It is possible that the concrete would absorb and take care of a thin coating of rust. But no chances are being taken on that. Removable ribs are employed to hold the lagging in place. At Bryn Mawr, narrow wooden strips making lap joint with each other were in use, upon the writer's visit. The concrete is dumped upon the crest of the pipe. The jacket of concrete completely envelops the tube, except where the cradles themselves are located. Prior to placing the concrete of the envelope, a grout is poured into the grooves arranged on the upper surface of the cradles. Access is gained from the side. This grout fills the system of grooves beneath the steel plate and effects a close joint.

The placing of the interior shell of cement mortar is one of the most interesting and important matters connected with the steel siphon work. This lining is required to have a minimum thickness of 2 inches and a smooth internal surface when finished. A little consideration will show that we have here a considerable problem. Of course, any satisfactory solution of the problem must be a commercial one. Considerable experimenting has been done.

A steel form presents perhaps the best surface adapted to securing the desired smoothness. It would, perhaps, be difficult to provide ribs strong enough and yet sufficiently flexible to permit slight variations in form to be made. The tube is not a circle—it is, rather, an ellipse. A device for blowing the grout on to the steel and thus building up to the required thickness was tried for a while. It seemed to put the mortar on satisfactorily, except that it left a rough surface expensive to smooth. On the Gilliespie contract, wooden forms are used. The bottom of the lining is put in by hand. The remainder—about 270 degrees—is placed at a single pouring when a section of form, perhaps 20 feet long, is ready. This consists of nine segments, each covering about 30 degrees. Each segment is a unit. They are all alike, so that no mistakes can occur in arrangement. Ribs giving strength to one segmental form interlock with ribs of the next one, and so on. The interlocking is secured by providing a tongue or protuberance on one end of a rib and a corresponding notch on the other. The tongue of one rib is placed in the notch of the rib next to it around the circle. We thus get a long rib of 270 degrees. Five struts are now put in place at a number of the 270-degree ribs. These extend from a joint on one side to the joint opposite on the other. They are easily placed, and easily taken down. Altogether, there are about 20 such struts used in setting one section of form. The struts contact at each end, not with the joints, but with intervening longitudinals. There is a simplicity and flexibility about this form that makes it quite successful. Metal stops are employed to regulate the distance between form and pipe. When all is ready, the pouring is accomplished by means of a tube running up through the roof. This permits the cement mortar to be furnished from an outside point. The tube is arranged at one end of the form. The end selected is the lower one. A hole is left open at the other end to provide a suitable vent. No provision is made for expansion and contraction. It is assumed, perhaps, with the pipe full of cold water and the exterior well protected there will be but a small variation in temperature.

The concrete on the outside and the cement mortar on the inside are to be considered as having no other service of importance to perform besides that of protecting the steel pipe. Time will alone tell how perfectly this has been accomplished.

Wells and Well Pumping Machinery.*

By Charles Brossmann, Indianapolis, Ind.

THERE is no definite record as to when man first had to secure water from wells, nor the reasons which made him endeavor to secure water from below the surface. No doubt at first water was used directly from the streams, which at that time certainly were pure; but the human family increased. By multiplication and dissension it spread to all corners of the land, after which wells are spoken of again and again in the Bible.

"And Isaac's servants digged in the valley and found there a well of springing water." Gen. 26:19. This seems to be the first mention of a flowing well.

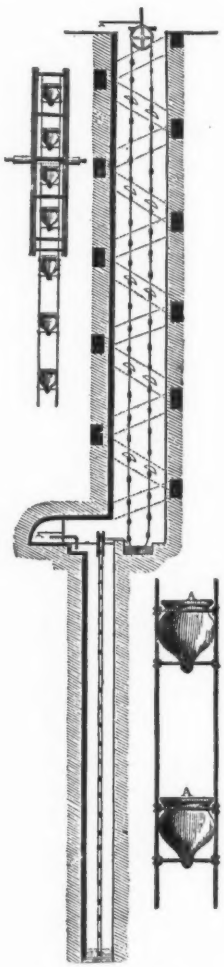
History and romance are singularly interwoven and associated with the description of wells. In Isaac and Rebecca's romance a well is mentioned. The well called Jacob's well is replete with ancient history. Numerous other instances are probably remembered by most of you.

No doubt the first wells were crude excavations, mere holes in the ground of very shallow depth and built wholly in soft materials; but, with the discovery of metal, wells were dug into the solid rock; not only shallow wells, but wells of prodigious depth for such times, and of no mean size, accurately fashioned and designed with a view toward permanency.

The well called Jacob's well, located on the road to Jerusalem, was used for 3,500 years by his descendants. The exact date of its construction is unknown. It is not known whether Jacob built this well himself. Sunk in the solid rock, this ancient hole drops to a depth of 105 feet and is 9 feet in diameter.

In Fig. 1 is shown one of the most remarkable engineering works of the ancients, Joseph's well at Cairo. This extraordinary well is nearly 300 feet in depth. For a depth of 165 feet through the solid rock it is 18x24 feet in section. At this depth is a relay chamber to receive water from the lower level of the well. The lower shaft extends 130 feet below through the rock into a bed of water-bearing gravel. The lower shaft of the well is 9x15 feet in section, the water from the bottom being raised to the 165-foot level by machinery, consisting of an endless chain of pots and toothed wheels; the motive power being horses or oxen. Making their countless rounds in this subterranean chamber, these beasts of burden raised the water from the very bottom to their own level; from there the water was again elevated the remaining 160 feet to the surface of the earth by similar beasts of burden.

Access from the surface of the ground to the lower chamber was obtained by a winding passage way following around



JOSEPH'S WELL.
Fig. 1.

the large shaft. This passage way is between 6 and 7 feet wide, and a little over 7 feet in height. Dropping with a very easy grade it winds around the well with a wall with little over 6-inch thickness

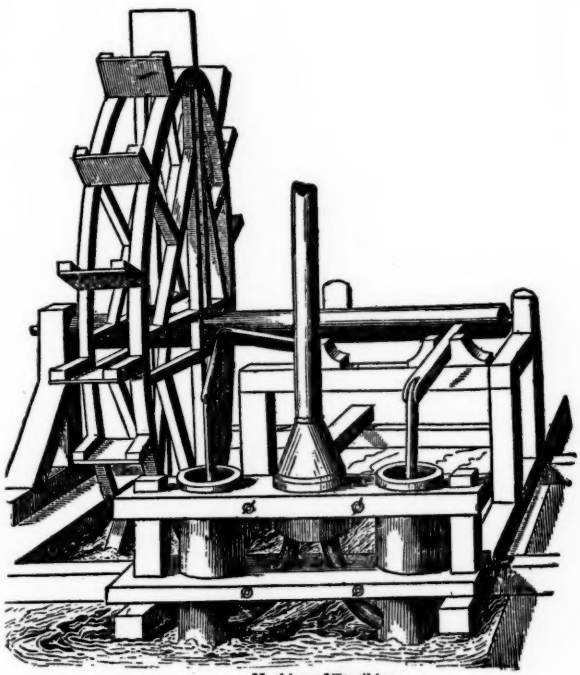
*From a paper before the Indiana Engineering Society.

between it and the well shaft itself. Built in the solid rock with such extraordinary care and accuracy, this well is truly remarkable; and it would be especially interesting to know more of the methods and tools used to build this great engineering work. The building of this well is commonly credited to Joseph, a patriarch of Egypt. Some scientists attribute this well to the same people who built the pyramids. Others, believing that Cairo is situated upon the location of the ancient city of Babylon, hold it to be part of the remains of this historic city.

The genius of some ancient engineer (believed to be Conon, residing in Egypt) is shown in the form of a screw pump used by the Egyptians and the Romans. This is usually named the Archimedean screw, after the man who introduced it. These pumps have been reinvented time and time again, some driven by hand and some by beast, and some even by water power. Pumps of this principle have only recently been taken up again, and with slight modifications and improved mechanical construction, give for moderate depths a machine that will displace a very large volume of water. Unlike the old machine, these of later day make are operated at very high speed.

An improvement of the chain of pots used in Joseph's will is the chain pump. The exact credit of its invention is clouded in the dim chronicles of mechanical history, but it is likely that its development is due to the Chinese.

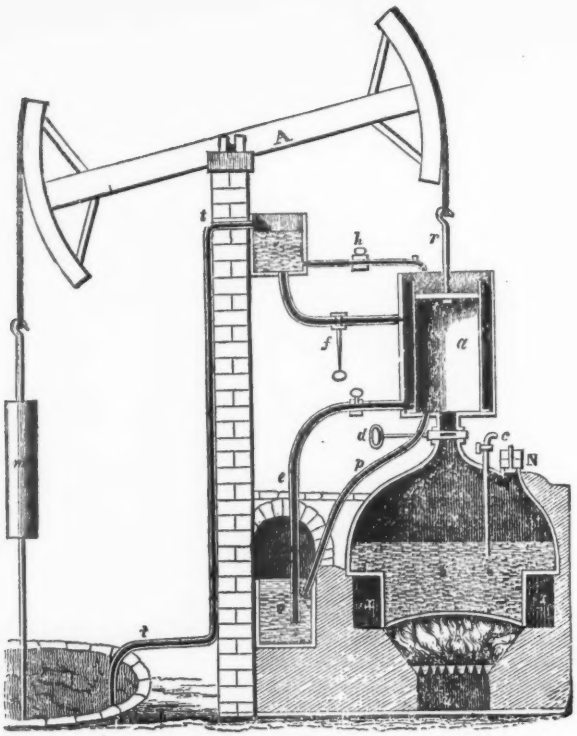
The syringe and the valve were evidently the forerunner of the improved pump of Ctesibius. This machine was the forcing pump of the ancients, and could force water to considerable heights. The improvement and combination of pistons, valves and air chambers giving a machine that produced a continued flow of water, entitled this ancient inventor to the thanks and regard of our modern engineers. Fig. 2 shows the pump of Ctesibius from the description of Vitruvius. The latter application of this old pump is herewith shown as used in the rotative machinery of the fifteenth and sixteenth centuries. Note the weighted arms showing the flywheel principle.



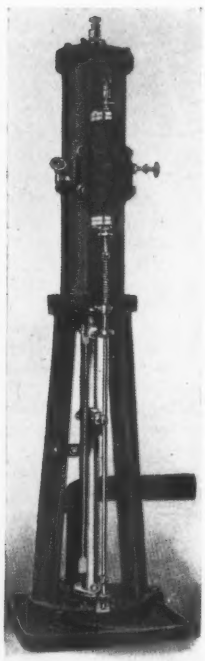
Machine of Ctesibius.
Fig. 2.

About 1641 the first suction pump was constructed at Florence, Italy. This led to the discovery of vacuum and atmospheric pressure by Torricelli. This natural law was even the subject of religious bickerings at that time. The bellows pump was, however, used over a hundred years before that time, but the above mentioned theory did not seem to be understood. The differential plunger pump is also mentioned about this period.

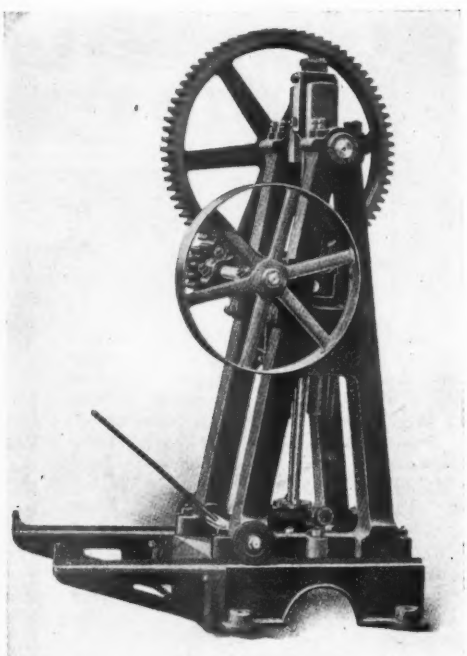
Heretofore all the machines described



Newcomen and Cawley's Engine. A. D. 1705.
Fig. 3.



DEEP WELL, STEAM HEAD.
Fig. 4.

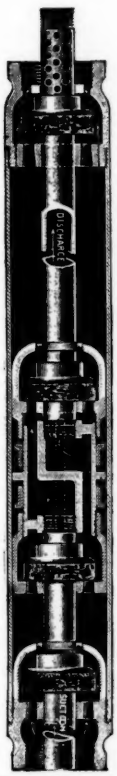


DEEP WELL, POWER HEAD.
Fig. 5.

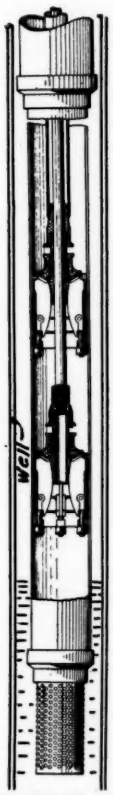
have been operated by manual labor, or by animals. In 1655 the Marquis of Worcester, England, mentioned his ideas on the raising of water by steam power; in fact, shortly after 1600 the use of steam for pumping water was causing comment in England. Rapidly following came the fire engine and machines of Papin, Savery, Newcomen, Cawley and others. The general form of Newcomen and Cawley's engine of the early part of the eighteenth century is shown in Fig. 3. Following motion to the plungers, the dead center of one lever was obtained before the other was passed, thus the column of water was always in motion without shock or vibration. Such pumps have been used in England with lifts of 150 and 200 feet. The original pump of this type was invented in 1780 by Taylor, of South Hampton. (Acknowledgement is made on parts of historical matter to "Ewbank.")

The pumps of the present day are in almost every instance modifications or

SINGLE-ACTING BARREL.
Fig. 6.



DOUBLE-ACTING BARREL.
Fig. 7.

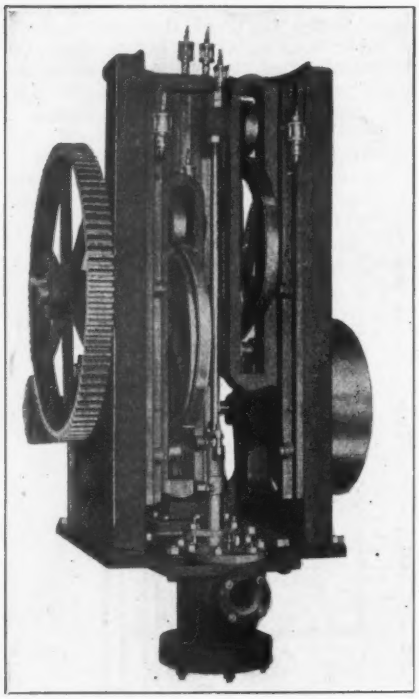


CONTINUOUS-FLOW BARREL.
Fig. 8.

these came the great improvement by James Watt, using steam expansively. The advent of the steam engine, of course, gave a corresponding impetus to the improvement in pumping machinery of every type, and during the years following the invention of utilizing the expansive force of steam rapid progress was made, and many machines were built that were efficient and reliable.

The Mather and Platt pumping engine for wells used a single cylinder and two plungers, one rod inside the other. This pump had two bell cranks to transmit the improvements over some of the older types of pumps, most of which have been mentioned above. The air lift and the internal explosion pump probably being exceptions.

The present day deep-well pumps may be classified as direct acting, rotary, centrifugal and the air lift or air displacement pump. The direct acting deep-well working barrel, either single or double acting, has been used probably more than any type of well pump, using generally a steam head (Fig. 4), or in many cases a power head driven by steam, gasoline or



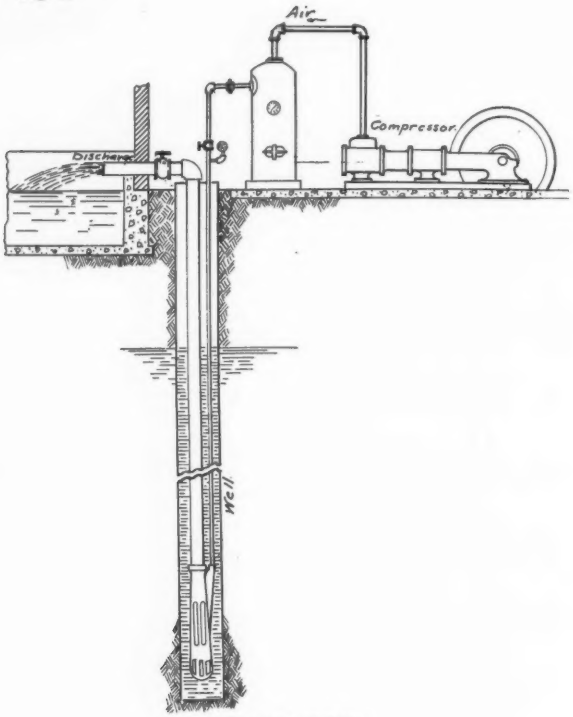
POWER WORKING HEAD FOR CONTINUOUS-FLOW PUMP.
Fig. 9.

electric power (Fig. 5). The single acting barrel is shown in Fig. 6, the water, of course, being discharged only on the up stroke. The double acting barrel, of which a type is shown in Fig. 7, gives a discharge on both the up and down stroke. The differential plunger pump gives a somewhat similar effect by using a single acting barrel with a displacement plunger placed at the discharge end.

Still another type is the continuous flow style of barrel, shown in Fig. 8. In this there are two plungers, the rod from the lower plunger being inside the rod from the upper plunger. These barrels are usually operated by power heads. In some the motion is given the rods by means of cranks and gears; in others, the rods are connected to rollers riding on cams. The claim for pumps of this class is that the double plunger gives a continuous flow without pulsation, which insures smoother and more economical operation.

Fig. 9 illustrates a power head for the continuous flow type using cams and rollers to operate the two plungers.

The air lift pump is operated by introducing a jet of air at the bottom of a water column. The air from its buoyancy forms bubbles, or an air piston which forces or displaces the water to the surface. The air lift is about as simple a

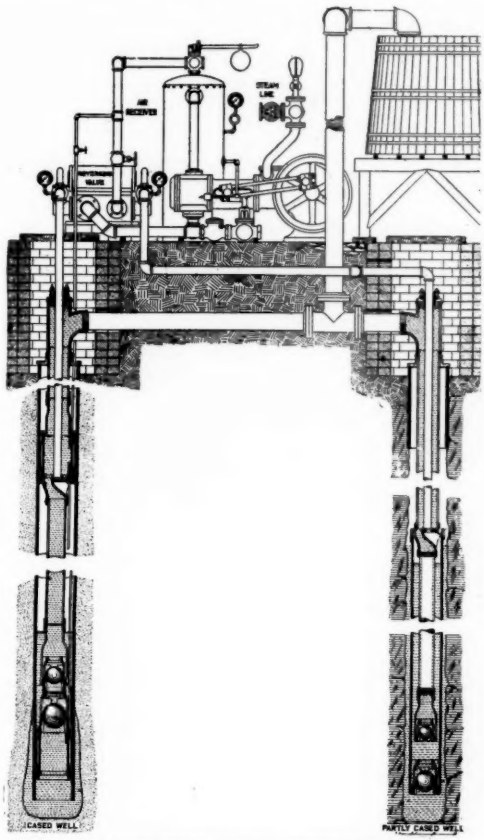


AIR-LIFT PUMP.
Fig. 10.

mechanism as can be placed in a well for the pumping of water. A compressor is placed at the surface, and the general arrangement of the outfit is shown in Fig. 10.

The air pump head itself is made in numerous forms ranging from a simple pipe with an opening at the bottom to those of more recent date, which are arranged to reduce to a minimum the frictional losses in the air and water. The air lift is most economically operated at a minimum of 60 per cent. submergence. Under proper condition this type of pump will deliver more water than the direct single or double acting deep well pump.

The displacement pump, operated by compressed air, consists of a compressor and necessary piping to the well, and the displacement pump itself placed within the well, and some type of automatic valve to regulate the inlet of air to the pump. In the simpler forms air is admitted to the pump in the well, forcing the water upward and discharging at some given point; the air is then exhausted in some cases into the atmosphere, or in some of the more recent types the exhaust being returned directly to the compressor, and a considerable saving being thereby effected. The important mechanism of such a system is the reversing air valve supplying the air to the pump. Fig. 11 shows the general arrangement of the return air system. The detail of the working barrel, it will be noted, is quite simple. No special submergence is required for this type of pump. The water fills the pump by gravity, after which the air pressure is applied and the water is forced upward until the water level in the pump chamber is close to the bottom, then the reversing valve cuts off the air supply, and connects the air compressor suction to the pump, the exhaust air being returned to the compressors, thus saving the wasting of air to the atmosphere.



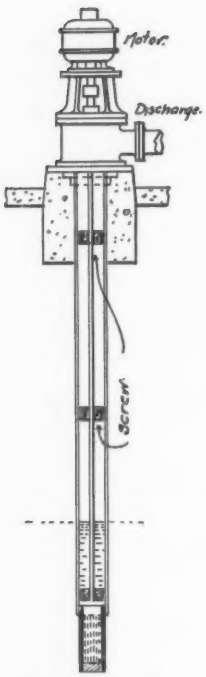
AIR-DISPLACEMENT PUMP. RETURN SYSTEM.
Fig. 11.

The pumps of the rotary class are improvements of the Archimedean screw or the centrifugal pump. Fig. 12 illustrates a modern pump of the screw type. These pumps are operated at high speed and

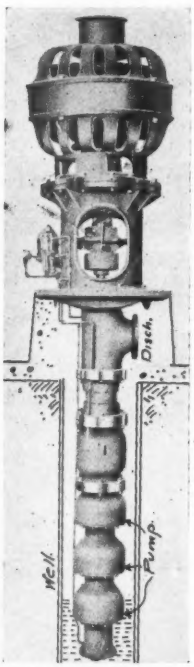
will discharge large quantities of water. They can be driven by steam turbine, electric motor or belt. In some instances an additional centrifugal pump is placed on the same shaft to raise the water from the surface to any desired elevation, thus giving a very compact installation. The impeller or screw pump itself, it must be understood, is used only for lifting from the well to the surface, the attached centrifugal at the surface being used for pressure. Fig. 13 illustrates a deep-well multiple stage centrifugal pump. This type of pump is capable of operating direct against fairly high pressures, but will not give as large amount of water as the impeller or screw type. The shafting is hung entirely from the top and is provided with ball or roller bearings, thus reducing friction to a minimum.

The general construction of the deep-well multi-stage centrifugal is shown in Fig. 14.

In the selection of a machine for any installation, the type will be governed by a number of conditions. The size of the well, its depth and the amount of water per minute that the well is capable of yielding, all have a direct bearing in determining the particular type of pump that is best suited for the well to be pumped. It will be found that in the majority of installations where water has to be pumped from considerable depth, it usually takes more power to get the water out of the ground than to distribute the water afterwards. Each installation should be carefully considered, and after the type of pump is determined that is most suited to the conditions found, comparisons can then be made between the various makes as to cost, efficiency, etc., and the proper selection can then be made.



SCREW PUMP, MOTOR DRIVE.
Fig. 12.



MOTOR DRIVEN CENTRIFUGAL PUMP.
Fig. 13.

SECTION OF WATER END CENTRIFUGAL PUMP.
Fig. 14.

EDITORIAL · COMMENT

Should a City Grant a Franchise to a Competing Public Service Corporation.—Obsolescence in Public Utility Plants.—Politics, Pull or Incompetency.

SHOULD A CITY GRANT A FRANCHISE TO A COMPETING PUBLIC SERVICE CORPORATION?

A correspondent asks a question concerning a franchise for a gas company which is answered in the "Question Department" and raises a question of public policy which merits some discussion. The city owns and operates an electric light plant and a company is asking for a franchise to furnish citizens with gas for cooking, lighting, etc. What would be the effect of this competition upon the revenues of the city's electric light plant, and what return should the company pay to the city for the franchise?

There are several sides to the problem and the balance can be struck only after a careful and detailed study of all the local conditions and possibilities. A few general suggestions may be made, however.

From the point of view of the company: The returns from the investment must be sufficient to pay the operating and maintenance expenses, depreciation of the plant and interest on the capital invested. To do this the price of fuel gas must be sufficiently attractive to induce the citizens to use the gas instead of coal or other fuel. Most of the use of fuel in a city located as far south as this being for cooking, it should not be difficult to do this, although a schedule of $2 to $1.25 such as that decided to be necessary for Taylorville, Ill., would not be low enough to induce the change from coal to gas unless the price of coal is high or the citizens are well-to-do and would use gas for its convenience and comfort without much reference to its price. To induce the use of gas for lighting the price of gas for that purpose must be low enough to compete with the electric light furnished by the city, and overcome the advantage of greater convenience which the electric light has. The rates for electric light which are charged by the city are not known, but they are probably lower than they would be if the plant were owned by a private corporation. The price for gas for lighting can therefore not be very high. This means, probably, that the income will be quite low as compared with the expenditures and reserves necessary to make and the company can hardly afford to pay any large percentage of its earnings as compensation for its franchise. It is quite probable that in so small a city the revenue from gas for cooking would not be sufficient to warrant the construction of a plant for gas only, although it might warrant some extra expenditure in a by-product coke-oven plant to utilize the gas which is generated in the process of making the coke. In an iron-smelting district a coke plant of this sort would be possible as the coke could be used in the iron furnaces and the gas would be a by-product costing little or nothing except for its distribution through the city.

From the point of view of the city: The pipes in the streets are a burden for which the city should have compensation. If the gas company is to have the share of business which is necessary to keep it alive, and the city's electric light plant now has a business as fully developed as it should be, the gas plant must take business from the electric light plant. This will reduce the revenues and the profits of the electric light plant. If, as is very probable in a municipal plant, the profits in the electric

light plant are small or there is a deficit, this will mean a payment from the general funds of the city to keep up the electric light plant, and so far as this is due to the competition of the gas plant, the city is justified in requiring from the gas company a payment for its franchise which will meet this reduction in revenues in addition to the compensation for the use of the streets. It is quite possible, however, that the electric light business has not been developed to its utmost, being a municipal plant, and that a well managed small gas plant could develop new business enough to live without interfering materially with the present business of the electric light plant, although interfering materially with its future development.

From the point of view of the citizens: Gas is a very desirable fuel, especially in cities of the far south, and would be a great convenience to the citizens, one for which they would doubtless be willing to pay a reasonable advance over the price of coal, but, unless the price is materially less, it would not displace electric light. It would seem to be hardly fair to require the taxpayers at large to pay a deficit in the electric light plant to help a part of the citizens to secure these benefits.

To one with some knowledge of the general possibilities in cities of the size named for electric light and gas business, but unfamiliar with the local conditions, it would seem that the prospects for a gas plant using the ordinary coal, water or oil gas process were not very flattering. But the investors may be left to decide this question for themselves. It is the city's duty to protect its own investments and other interests by proper safeguards and payments in case the investment is decided upon by the company. Careful study by one familiar with the class of problems should be made and his report used as the basis for franchise requirements.

Even then a strict reading of moral and business principles should induce the city officials to consider carefully the propriety of granting such a competing franchise, without the assurance through this report or otherwise that the conditions are so favorable that future serious trouble and loss will not result to city or to company. Some future city administration may find it necessary, or at least expedient, to donate the remnant of the city's electric light plant to the gas company to reconstruct and operate for its own benefit. Such things have happened where local influences, political or otherwise, have resulted in neglect and consequent rapid depreciation of the municipal plant.

OBSOLESCENCE IN PUBLIC UTILITY PLANTS.

Prof. Halford Erickson, of the Wisconsin Railroad Commission, presented a paper on February 15 before the Indiana Sanitary and Water Supply Association on the methods of appraising public utilities used by the commission of which he is a member. In the discussion of the paper Prof. J. D. Forrest, who is now the manager of the Citizens' Gas Company, of Indianapolis, asked a number of questions, among them one as to the proper practice in allowing for obsolescence in apparatus not wholly depreciated but rendered useless by the advance in the art whereby improvement in service or increase in economy of operation demands replacement by more modern inventions.

There are some points in this connection which are occasionally mentioned, but which do not often receive full attention, to which Professor's Forrest's attention may be called. A company does not of its own motion dispose of old machinery and replace it with new unless it expects full return from the new investment. Under a certain progressive management of a prominent railroad the men in authority in the shops were informed, when they wished to make improvements, that whenever they could show a saving by new machinery which would pay 10 per cent on the cost of installing it, authority would be given for making the change. The evident expectation was that the improvement would pay for itself and that the plant would be increased in value by the re-

sultant difference between the value of the old machine and the new one. So in making a valuation of the plant, the old machine might be written off entirely and the new one written in with depreciation deducted from the date of its installation. This would allow the good judgment of the managers to receive as a dividend the increased returns from cheaper operation or increase of business, as well as the interest on the increase in capital, and they could well afford the deduction of the remnant of value of the old machine. If the judgment of the managers was not good and the returns were not as great as was expected, they would still have the increased valuation of the plant on which interest and depreciation must be computed in fixing the charges which the rates must be large enough to meet.

It is hard to see why any allowance should be made for future obsolescence in fixing a depreciation rate for the future, if the company of its own motion makes such replacements with more efficient machinery. It then exercises its own judgment as to the chances for profit in making the change and gains or loses according to whether that judgment is proven good or not, a matter with which the patrons of the utility or the public have no concern.

If, however, a financial improvement by the change cannot be demonstrated, and therefore the company refuses to make it, and the public or the patrons desire the better service which the change would bring, then they should pay the deficit arising from the increased expense under the changed conditions, a sufficient addition to the capital account should be made to insure the proper return to the company, and the rates should be raised to meet the additional charges. Such occurrences are so exceptional that it is impossible to make any general prediction concerning them, and each case must therefore be treated when it arises. Some such cases have arisen, especially in telephone service, under the Wisconsin commission and they have been treated in accordance with the principles stated.

In other words, as has already been shown several times in MUNICIPAL ENGINEERING, there is no justice in making a charge for obsolescence if the company makes the replacements of its own motion, for it is expecting to profit by them, and if the patrons demand the replacements they are really demanding better service, and if that service costs more than the old service they should pay the difference. They are paying for better service, however, and not for obsolescence, so that, whatever the fact may be as to obsolescence of machinery, there should be no charge under that name in the financial accounts.

POLITICS, PULL OR INCOMPETENCY?

In a city, which shall be nameless here because the occurrence is not so unusual as it should be, and what may be said is therefore of quite general application, the garbage disposal question has been under discussion for about two years. The serious study of the problem was first made by a committee under the direction of the city's efficient health officer and with the aid of a civil engineer who was familiar with the difficulties to be met and with the methods of meeting them.

A general plan for sanitary and economic collection and disposal of the garbage was formulated and presented to the city council, by which it was discussed for some time. Attempts seem to have been made by interested parties to induce the council to adopt one or another of certain methods of disposal without opening the matter to competition, but ultimately the preparation of plans and specifications was referred to the city engineer and they were prepared in consultation with the engineer referred to. Again there was difficulty in keeping the competition open, but changes in the specifications to this end were successfully resisted. Bids were received and were held for consideration for some time, but no way opened for influencing the award in the desired direction. They were rejected and new bids were called for on the ground that if the contracts were divided so that contractors could bid on buildings and apparatus separately

better prices could be obtained. This claim was supported by the results, the total of the two lowest responsible bids being somewhat less than the lowest responsible bid under the first advertisement. There was no change in the situation, however, for the lowest responsible bidder at the first letting was again the lowest bidder for furnishing and putting in place the machinery and apparatus, and by a difference too great to be ignored.

In the meantime another complication had arisen, whether through the agitation of those trying to secure a "pull" or of political opponents of the administration. The most available site for the plant from almost every point of view happened to be owned or controlled by persons quite close to the administration, and, although the price and terms were wholly unobjectionable, the suspicions expressed had enough influence to prevent the acceptance and purchase of the site by the council, and so the final award of the contracts and orders to proceed with the construction have been delayed by the lack of a site on which to locate the plant.

Then comes an election and a new administration comes into office. This administration ignores wholly the work of the preceding administration, including its engineering department, makes no new plans for garbage collection and disposal but advertises for bids for collection and disposal; the collection under no specification except that it "be made directly from the receptacles of the producers" once a week for five winter months and twice a week for the rest of the year; and the disposal under the specification that it must be satisfactory to the state health department.

The consequence of this advertisement is two bids, one of which is perfectly definite as to price to be paid, and the other has a definite price "per family per month" but no definite method of determining the number of families served and the total payment to be made. Neither is there any information as to the methods of collection to be used nor of disposal, nor any provision for sanitary or business control of the carrying out of the contract.

The case seems to concentrate in it all three of the objectionable elements mentioned in the title to this article, but is not exceptional on that account. As is most usual in such cases, the "pull" has been kept well out of sight, but politics have been more evident, while incompetency due mainly to ignorance has been evident in several places, but particularly in the latest developments.

Reformers have been trying to improve these conditions, in the first place by concentrating responsibility for expenditures and for competence of service by taking the administrative functions away from the legislative body and providing methods of placing the treatment of technical questions in the hands of technical men who have a tenure of office not terminable for reasons of policy or politics; second, by removing the choice of candidates for office as far as possible from the manipulations of professional politicians, in the bad sense in which that term is used at present; and third, by placing the supervision of the processes of spending money and the bookkeeping of the city under a state board, also as free as possible from the influence of policies and politics as well as the local city influences.

Scarcely any cities have all these safeguards, and the city in question has none of them. That it is in dire need of them all, the evidence in this case alone demonstrates conclusively.

THE QUESTION DEPARTMENT

Franchise for Gas Company.

This city is being asked to grant a franchise to furnish the citizens gas for cooking, lighting, etc. The city has its own electric light plant and it is a valuable asset, but the city does not care to go into the gas business. We would therefore be very thankful if you will give us some data on the subject of gas franchises, something in connection with the present grants in the various small cities of near 10,000 population.

What per cent. of the gross earnings should be exacted? The maximum price that should be charged citizens? In your opinion what effect would the installation of gas have on our electric light revenues?

L., City Clerk, ———, Ala.

The following extracts from a franchise recently granted Taylorville, Ill., may serve as a guide for the consideration of a franchise suited to the local conditions in this Alabama city. No franchise can be copied exactly for any other town or any other company than that for which it was made originally.

ORDINANCE NO. ———.

Being an Ordinance granting to the Taylorville Gas and Electric Company, a corporation organized under and by virtue of the laws of the State of Illinois, the right to construct * * * and to lay down, maintain and operate, along, in and under the streets, alleys and public grounds of said City hereinafter specified, all pipes, mains and fixtures necessary for the conveying and distributing gas for illuminating, heat and power purposes.

Whereas, the Taylorville Gas and Electric Compan has presented a petition to the City Council of the City of Taylorville, Christian County, Illinois, requesting an Ordinance granting to the said Company the right to occupy certain streets, alleys and public grounds with its necessary appurtenances for the distribution of electricity, gas and steam.

Whereas, petitions signed by the property owners fronting upon streets, alleys and public grounds hereinafter set forth have been presented to the City Council and filed in the office of the Clerk of said City of Taylorville, the said petitions being signed by the owners of the majority of the foot frontage along each streets, alleys and public grounds hereinafter specified, as is required by law;

Therefore, be it ordained by the City Council of the City of Taylorville:

Section 1. That the Taylorville Gas and Electric Company, its successors and assigns, is hereby authorized and empowered and the right, and privilege and franchise be and is hereby granted to the said Taylorville Gas and Electric Company, its successors and assigns, to * * * (concerning electric light).

And the said Taylorville Gas and Electric Company its successors and assigns are granted the right, power, license and permission to lay down all necessary mains, pipes, connections, fixtures and apparatus and to maintain and operate the same in and under the following named streets, avenues, alleys, and public area ways in said City, for the purpose of conducting and distributing gas to the citizens of the City of Taylorville for illumination, heat and power purposes, viz. * * * .

Section 2. The use of such streets, alleys and public grounds for the purpose herein set forth, by the said Taylorville Gas and Electric Company, shall be subjected to and governed by the Statutes of the State of Illinois, in relation thereto, now in force or hereafter to be enacted, and subjected to the Ordinances of the City of Taylorville, in relation to telephone, telegraph, electric light, gas and steam companies, or corporations, now in force or hereafter to be enacted.

Section 3. No poles, wires, fixtures, conduits, pipes or mains, or other implements or appurtenances, or other use or occupation of any of the additional streets and alleys of said City for the conveyance and distribution of electricity and gas, shall be permitted or enjoyed by the said Taylorville Gas and Electric Company, until proper petitions therefor, in accordance with the Statutes of the State of Illinois, shall be presented to the City Council of the City of Taylorville; and permission granted by said City by a proper Ordinance for the use and occupation of such streets, alleys and public grounds, as set forth in said petitions, and subject to the conditions contained in this Ordinance. And said Company shall, as far as practicable, make such extensions in and upon alleys of said City, and shall extend its system as reasonable demands arise so as to supply at all times the reasonable demands of said City and its citizens.

Section 4. (Concerning electric light.)

Section 5. (Concerning electric light.)

Section 6. (Concerning electric light.)

Section 7. That the said Taylorville Gas and Electric Company, its successors and assigns, in the installation and furnishing of said electric light, heat and power plant, and gas and steam heating plant, its appliances, appurtenances and apparatus shall be subject to the Ordinances of the City of Taylorville, in relation thereto, which are now in force or shall hereafter be passed by the City Council of said City of Taylorville. And said Company shall adopt reasonable and proper regulations to insure the safety of the public, and all persons of said City, to avoid injury to persons and property in said City.

And if said Company in erecting its poles and laying its pipes and mains or replacing or removing the same, or any other appliances or appurtenances shall disturb the condition of the streets, alleys, or public grounds, or other property of the City of Taylorville or belonging to any of its citizens, it shall restore to its original and proper condition, such streets, alleys, public grounds and private property, in as good condition as originally found.

And all excavations in said streets, alléys or public grounds for the construction or repair of the aforesaid poles, mains, pipes, appurtenances and works, shall be made under the supervision of the Street and Alley Committee of the said City; and where made in or upon paved streets, such excavations shall be governed by the Ordinances of the City of Taylorville, in such case made and provided; and when it is practicable all of said pipes for gas and steam, and conduits for underground wires shall be laid in and along the alleys in preference to the streets and sidewalks.

Section 8. In the event of the making of any public improvements hereafter, in the streets, alleys or public grounds of said City, in and upon which the said Taylorville Gas and Electric Company has erected poles, wires, conduits, or other appurtenances or apparatus, it shall be found necessary or proper to change the location of any or all of the said poles, wires, conduits, appurtenances and apparatus, such changes shall be promptly made by said Company upon receipt of notice from the said City of Taylorville, and if said changes are not promptly made, within a reasonable time after such notice, the City hereby reserves unto itself the right to remove all such poles, wires, conduits, appurtenances, and apparatus, from such streets, alleys or public grounds, and collect the cost and expense thereof from said Company. And if said Taylorville Gas and Electric Company shall not promptly pay such costs or expenses on demand, the same shall be taken and held by the parties to be grounds for the revocation of the rights and privileges of said Company, on the streets, alleys, and public grounds affected.

Section 9. (Concerning electric current.)

Section 10. (Concerning steam heat.)

Section 11. Said Taylorville Gas and Electric Company shall furnish gas unto the City of Taylorville and to all persons, companies or corporations living along or upon the streets alleys and public grounds of said City, occupied by said Company with its gas mains, pipes and other appliances for the transmission of gas, upon proper application being made to said Company for said service by such person, persons, company or corporation, subject however to all rules and regulations which may be adopted by said Company which shall be just, equitable and uniformly applicable to all other persons, companies and corporations receiving the same, or similar services, and shall charge the same rates for the same amount of service to all such persons, companies and corporations similarly situated and under similar circumstances, without discrimination except on behalf of the City of Taylorville. And said company shall furnish gas for illumination, heat and power to any person, persons, company or corporation making application therefor as hereinbefore provided, at not to exceed the following maximum rates:

* * *

Section 12. It is further expressly provided, that said Taylorville Gas and Electric Company shall present to each consumer of electricity and gas, a written or printed statement of his account, which statement shall contain the date of the two prior meter readings: the total difference between the two said readings, the rate, and the total amount charged; and shall bear in a prominent place, either on the face of said statement of account, or on the back thereof, a schedule of the rates in force at the time of the reading of said meter.

And it is further expressly agreed that said Company shall not read meters for any person, persons, company or corporation, at less intervals than thirty days, except by consent of such consumer, or in the event that service by said Company shall be discintinued for any cause.

Provided further that any person, persons, company or corporation obtaining service from said Company through a meter installed by said Company, may have the same tested, and the results thereof delivered by the said Company to consumers, at any time after reasonable notice to said Company(for which service, said Company may at their option, charge a fee of 25c for such examination, to be charged and collected as for other services). Such tests may be required at reasonable intervals, not less than six-months, and shall be made under the supervision of some one person authorized by the City Council of the City of Taylorville, and in the presence of such person, persons, company or corporation, asking for the test, on the premises of such consumer and the results of such test duly attested by such person representing the City of Taylorville.

Section 13. Either party shall have the right to have either or all of the above and foregoing rates revised and determined after sixty days notice to the other, but not oftener than once in five (5) years, during the existence of this grant, but it is expressly agreed that no changes in the maximum rates hereinbefore established or to be hereafter established, shall be made by the said Company, without the consent of the City Council of the City of Taylorville, expressed by ordinance, duly passed and approved, and no changes shall be made as herein provided until after a period of five years.

If either party shall give notice as herein provided, for a change in the maximum rates, and the said City of Taylorville and the said Company fail to agree upon what shall be taken and held to be a proper maximum charge for electric current and gas for light, heat and power, or either of them, the same shall be submitted to a Board of Engineers, consisting of three disinterested Engineers, to be selected by the City, and by the Company in such manner as may be mutually agreed upon, but no one of whom shall be considered, nor to be the representative of the interests of either the City or of the Company, which said Board of Arbitration shall investigate the question of the reasonableness of the charges contained in said notice, and make a report thereof to the City Council and said Company, which said report shall be binding upon the parties hereto, as to the reasonableness of the charges, submitted to such Board of investigation and report.

And should such Board find that a change should be made in such maximum charge or either of any of them, the City Council shall, by proper ordinance, fix the maximum charge for electric current and gas for light, heat or power and steam for heating purposes, or any or either of them, as found by said Board of Arbitration, which said maximum charge, shall be and remain the maximum charge for such electrical current or gas for the period of five years next succeeding, and until changed as herein provided, and the costs and expenses of such arbitration shall be borne in equal parts by the said Company and the said City of Taylorville.

Provided, however, that such Board of Arbitration shall not take into consideration, the value of any franchise granted by the City of Taylorville to said Company, or to any other person, persons, company or corporation, and owned or controlled by the said Taylorville Gas and Electric Company.

And both the City and said Company shall render such aid and assistance to said Board as they may require, to enable them to reach a decision with regard to the rate or rates under consideration.

Section 14. It is further expressly provided, and is one of the considerations moving from said Company to said City, that the said Taylorville Gas and Electric Company,

promises and agrees to and with said City, that during the existence of this grant, it will furnish free of charge from its electric and steam heating plant, the steam for heating purposes, for the Public Library Building, and City Hall building in said city, all free of charge to said City.

Section 15. (Concerning street lighting.)

Section 16. The rights hereby given to the said Taylorville Gas & Electric Company shall not be deemed exclusive, but the City of Taylorville expressly reserves the right and power to grant a like franchise to any person, persons, company or corporation, covering the same streets, alleys or public grounds in said City, the same however, not to nullify or interfere with any of the powers, rights or privileges, or the reasonable exercise of the same which are hereby granted.

Section 17. It is further expressly provided, and is one of the considerations for the grants in this Ordinance contained, that the said Taylorville Gas & Electric Company, its successors and assigns shall save and keep harmless the city of Taylorville, at all times and during the existence of this grant or franchise, from any and all costs, and expenses, damages and liabilities of every kind, and character, arising from or growing out of the exercise of the rights and privileges, or any of them herein granted, and the said Taylorville Gas & Electric Company, for itself, its successors and assigns, covenants and agree to reimbure and repay the said City, on demand, any and all moneys that it shall be compelled to pay or become liable to pay, growing out of or resulting from the exercise by said Taylorville Gas & Electric Company, its successors, or assigns, of any of the rights or privileges, given or granted to it, by the Ordinance, and nothing in this Ordinance contained shall be construed to release said Company, its successors or assigns from its or their liability, arising from the occupation by said Company of any public square, street, alley or other public or private grounds in said City.

And it is one of the conditions of this Ordinance that said Taylorville Gas and Electric Company, shall upon accepting this Ordinance as herein provided, file in the office of the City Clerk, an indemnifying Bond to the people of the State of Illinois, for the use of the City of Taylorville or any person interested, in the penal sum of Ten Thousand Dollars, conditioned upon said Taylorville Gas & Electric Company, its successors and assigns, saving and keeping harmless, the city of Taylorville from all suits, damages, judgments, costs and expenses, and liability of every kind and character, consequent upon or resulting from the exercise by said Company, its successors, assigns, agents, or employes, of any or all of the rights and privileges, or any of them herein granted, and to repay to the said City of Taylorville, all moneys it shall have been required to pay on account of, or resulting from the granting of the rights and privileges herein contained, and from the exercise thereof by said Company; said Bond may be either a personal bond or furnished by some casualty or indemnity Company authorized to do business in the State of Illinois, and all subject to the approval of the City Council of said City; for good cause the City Council of said City may require said bond to be renewed or additional bond given if deemed necessary for the protection of the City of Taylorville.

Section 18. If the said Taylorville Gas & Electric Company shall fail, neglect or refuse to comply with the material provisions of this Ordinance or any or either of them, or to carry out the stipulations and agreements on its part to be kept and performed; or shall make default in complying with any lawful ordinance, now in force or that shall hereafter be passed, or with any statute of the State of Illinois, now in effect or that shall be hereafter enacted, relating to the rights, powers and privileges herein granted, or the business of said Company, and shall fail to comply with such ordinances or statutes, within thirty days after notice of such default:

Or if the said Tayloville Gas and Electric Company shall fail to operate its electric light plant continuously during the term of this grant, except such failure shall result from unavoidable injury and accident to the plant, or to the machinery therein contained, or to strikes, lock-outs, or the acts of Providence:

Or if the said Taylorville Gas & Electric Company shall be guilty of willful overcharges or discrimination between consumers other than the City of Taylorville, or giving of rebates, or entering into combination with any other person, persons, company or corporation, in restraint of competition, or for fixing or maintaining prices in the business in which said Taylorville Gas & Electric Company is engaged, or shall enter into collusion with any other person, persons, company or corporation, for the purpose of fixing or maintaining prices, and thereby preventing free and competitive bidding for the contract for the lighting purposes of the streets, alleys and public grounds in said City, then and in any or either of said events, all rights, privileges and franchises granted by this Ordinance, may be declared forfeited, by the City Council of the said city of Taylorville, by proper Ordinance passed therefor. And in such event, said Taylorville Gas & Electric Company shall forthwith proceed to remove all poles, wires, fixtures, appurtenances and apparatus belonging to it, from the streets, alleys and public grounds of said City, and upon its failure so to do, the City shall have full power and authority to remove the same at the expense of said Company.

Section 19. If the said Taylorville Gas & Electric Company shall assign their rights, privileges and license granted to it by the terms of this Ordinance, they shall file a notice in writing at the office of the Clerk of the City of Taylorville giving the name and address of the assignee and if the said assignee shall exercise any of the rights, privileges and licenses granted in this Ordinance, it shall be deemed to have accepted all the terms, conditions and limitations in this Ordinance contained, and subject to all duties, responsibilities and liabilities imposed upon said Taylorville Gas & Electric Company.

Section 20. The powers, provileges and license contained in this Ordinance for the occupation of the streets and alleys of said City, for the operation and maintenance of poles, wires and other apparatus for the conveyance and distribution of electricity for current unto the Taylorville Gas & Electric Company, its successors and assigns, for a period of twenty (20) years next succeeding the date of passage of this ordinance, and the rights, privileges and license contained in this ordinance for the use and occupation of the streets and alleys of said City for laying down, maintaining and operating pipes, mains, and other apparatus, for the conveyance and distribution of gas and steam is granted to the Taylorville Gas & Electric Company for a period of twenty-five (25) years next succeeding the date of the passage hereof, subject to the conditions contained in this ordinance. And upon the further condition that the said Taylorville Gas and Electric Company shall file an unconditional acceptance of this Ordinance in writing in the office of the City Clerk of the City of Taylorville within twenty (20) days after the date of the passage of said Ordinance. And upon the termination of the

period of the grants herein provided for the said Taylorville Gas and Electric Company shall remove all poles, wires, appurtenances, appliances, apparatus, for the transmission and distribution of electricity from the streets, alleys and public grounds of said City. And shall cease to use the streets, alleys and public grounds of said City for the conveyance and distribution of gas and steam, and any failure to comply with the terms of this section within sixty (60) days after the expiration of this Ordinance shall authorize the City to have the same done and performed. And the said Taylorville Gas and Electric Company, its successors, and assigns shall have no further rights by virtue of this ordinance unless granted by Ordinance of the City of Taylorville, or its legal successor.

The rates for gas proposed in the above franchise not being satisfactory to the company, they were left to the determination of an arbitration Board appointed under its terms. This Board fixed the maximum rates as follows:

First 500 cu. ft. or less used in any month, $2.00 per 1,000 cu. ft.
Next 2,500 cu. ft., $1.75 per 1,000.
Next 7,000 cu. ft., $1.50 per 1,000.
All in excess of 10,000 cu. ft., $1.25 per 1,000.

It will be noted that this franchise is granted to a company which is operating both the gas and the electric lighting systems, and there is in this case the additional complication that those who control the company also practically control the supply of coal for domestic uses, a condition which seems to have been ignored in fixing the rates for gas.

In the case of the Alabama city there is probably opportunity for competition between coal and gas, so that if the gas company wish to introduce the gas for fuel they must make the price for fuel gas low enough to be attractive. Although not so stated definitely, it is assumed that the city's electric light plant furnishes light to citizens as well as for street lighting. To secure any lighting patronage the company must make their prices for gas lighting attractive to the city's electric light customers enough to induce them to change to their service. Unless the gas is a by-product, as it is in the case of the Otto-Hoffman and like coke-oven processes, the chances for the profitable operation of a gas plant do not seem to be very promising, and, from the point of view of the company, it could not afford to pay a large return, if any, to the city for its franchise. On the other hand, the company must get lighting business from only two sources, development of new business and taking business from the city's light plant. The city certainly has the right and duty to protect its electric light plant from this competition or to secure from the gas company a return sufficient to make up for the loss in net profits of the electric light plant due to the gas company's competition. This phase of the subject is discussed somewhat in detail in the department of "Editorial Comment" on another page of this issue of MUNICIPAL ENGINEERING.

This is evidently a case in which a careful study by one experienced in the franchise field from the municipal standpoint is a necessary preliminary to intelligent action.

Street Railway Franchises.

I have been appointed secretary of the committee on public utilities of our city government and we are now investigating the franchise rights of the street railway company operating in our city. We are very anxious to obtain as much light as possible on the matter. I have been informed that you would be able to give us something in relation to the question of franchises, etc., in various cities of the country and ask that you would kindly let me know as soon as possible, if you could send what you would deem helpful in investigating such a question? G., ——, Me.

MUNICIPAL ENGINEERING has much that will be of assistance in the consideration of this question. With reference to franchises in general the discussion of depreciation and sinking fund accounts in vol. xxxix, p. 26 may be of interest; also the article "A Municipal Franchise is a Valuable Asset and Should be so Treated," vol. xxxv, p. 301.

Regarding street railway franchises in particular the following articles will be found valuable: "Report of the St. Louis United Railways Investigating Committee," vol. xli, p. 64; "Valuations of Public Service Corporations," vol. xxxix, p. 200; "Railway Company Must Comply with Paving Specifications," vol. xxxix, p. 301; "Percentage of Receipts as Compensation for Street Railway Franchises," vol. xxxviii, pp. 317 and 340; "Payments for Street Railway Franchises," vol. xxx, p. 276, being a compilation of information from the U. S. Census Bureau report on street and electric railways.

Some provisions in franchises for other public utilities may be applied in modified form to a street railway franchise, such as those stated in an article on cooperative franchises for municipal public service corporations in vol. xxxviii, p. 335; "An Outline of a Contract Between a City and a Water Works Company," vol. xxxvi, p. 247; "Terms of a Water Works Franchise," vol. xxxvi, p. 177; "Franchise Terms and Rights," vol. xxiii, p. 166; "Some Provisions in Modern Franchises for Municipal Public Service Utilities," vol. xxxix, p. 456; "Principles Underlying a Street Lighting Contract," vol. xxxv, p. 96; "A Modern Municipal Franchise," vol. xxxv, p. 306; "Factors That Should be Considered in Making Street Lighting Contracts," vol. xxxviii, p. 393.

There are many other articles in these and other volumes which can be referred to if the subject is to be studied in great detail.

Among the books treating the subject probably Wilcox's "Municipal Franchises," (2 vols. $10), is the most complete. Over 600 pages of the second volume are devoted to transportation franchises, three-fourths of this space treating of street railways. The

three volumes of the report of the National Civic Federation on "Municipal and Private Operation of Public Utilities" has much of value, and can probably be obtained for the publication price of $10. About 100 pages of the third volume are devoted to street railways, and the general discussion occupies a small part of the first volume. The annual reports of the state public service commissions may also be useful, particularly those of the Wisconsin Railroad Commission and of the two New York Public Service Commissions.

The safest course to pursue is to insure a competent committee and then to obtain detailed technical assistance from competent experts of experience in franchise matters.

Terms of Electric Light Franchise.

I wish to ask your assistance on a matter of drawing up a franchise for electric light plant.

1. Should there be anything said in the franchise about the kind of service and if so what? That is something about the kind of power, etc.

2. What is a 2000 C. P. arc light? Should there be some method of testing the lights and power?

D. R. J., City Attorney, ———, Ind.

MUNICIPAL ENGINEERING has a number of articles on this subject, a list of which will be found in vol. xl, p. 37, in articles on "Specifications for Electric Lighting Contract" and "Electric Light Franchise."

Enforcement of Collection of Local Improveemnt Assessment Against Railroad.

I have this question, namely, right to sell part of the right of way of a railroad by force of execution on local assessment for abutting improvement.

I would appreciate your early reply with such cases as you have access to.

M., City Attorney, ———, Ga.

The Cyclopedia of Law and Procedure, p. 1211, says "The rule generally recognized is that the road-bed or right of way or other property so connected with the operation of a railroad that its loss by conveyance or sale would dismember the road as a line of travel cannot be sold to satisfy a local assessment, but that other property of a railroad may be subjected in the same manner as property of individuals." Cases cited are Kansas City, etc., R. Co. v. Silvan Springs Water Works, Imp. Dist. No. 1, 68 Ark. 376, 59 S. W. 248; Minneapolis, etc., R. Co. v. Lindquist, 119 Iowa 144, 93 N. W. 103; Boston v. Boston, etc., R. Co., 170 Mass. 95, 49 N. E. 95; Detroit, etc., R. Co. v. Grand Rapids, 106 Mich., 13, 63 N. W. 1007, 58 Am. St. Rep. 466, 28 L. R. A. 793.

On the opposite side are Chicago, etc., R. Co. v. Elmhurst, 165 Ill. 148, 46 N. E. 437; Cleveland v. Cleveland, etc., R. Co., 4 Ohio Dec. (reprint) 315, 1 Clev. L. Rep. 304, holds that a special assessment on a street railway gives the city a lien on the franchise and track of the company for the payment thereof.

Terminal property, i. e., freight house, road bed and right of way cannot be sold to raise local assessments, is decided in Lake Shore, etc., R. Co. v. Grand Rapids, 102 Mich. 374, 60 N. W. 767, 29 L. R. A. 195.

That personal property of a railroad company can be levied upon and sold to satisfy assessment for local improvement is decided in Atchison, etc., R. Co. v. Peterson, 58 Kan. 818, 51 Pac. 290, affirming 4 Kan. App. 103, 48 Pac. 877. Other cases in this line are Philadelphia v. Philadelphia, etc., R. Co., 177 Pa. St. 292, 35 Atl. 610, 34 L. R. A. 564; and 1 Pa. Super. Ct. 236, 38 Wkly Notes Cas. 15.

Legality of Extension of City Limits.

I have a knotty little legal question on hands now, which you may be able to give me some assistance on. It is this: This city is a city of the Fourth Class, organized under the general statutes of Missouri. The city recently attempted to extend its limits by ordinance over some adjoining territory. The extending ordinance was regularly passed, and the special election required by our statute was held at the same time and place of the regular city election of city officers, and carried by a large majority of the vote cast. Now, the State, by information of the prosecuting attorney, at the relation of one of the annexed tax-payers, files its information in the nature of a quo warranto, questioning the legality of the extension on the following three grounds only: (1) Because the notice of the special election was insufficient, in that it simply published in full the extending ordiinance; (2) Because this notice was not given sufficient publicity, being published in the newspaper with smallest circulation in the city; and (3) Because the place of holding the special election was not properly designated. The last mentioned point is the only one of which I have any fears. The extending ordinance only described the place for holding the special election, as "the same place as that of the regular city election."

As city attorney, I am trying to uphold the extension of the city limits. If you can cite me to any authorities to uphold my side of the case, I shall be thankful. Our courts have held that the electors are presumed to know where the place is for holding the regular elections. So that being true, they are, then, therefore, presumed to know where this special election was held.

M., City Attorney, ———, Mo.

In the Cyclopedia of Law, vol. 15, p. 326, under the title "Elections," it is said that where an election has been held and the will of the voters has been executed by the proper authority, it may be presumed that due notice of the election was given under the rule that where performance of a prior act is necessary to the legality of a subsequent act, proof of the latter carries with it a presumption of the due performance of the former." Cases cited are Brownell v. Palmer, 22 Conn., 107; Knox County v. N. Y. City Ninth National Bank, 147 U. S., 91, 13 S. Ct., 267; in re Walker, 3 Luz. Leg. Reg. (Pa.) 130; Clark v. Wardwell, 55 Me., 61.

Also, "Proof of order to post notice of election is sufficient" even if the order was not obeyed by the proper officer: San Luis

Obispo County v. White, 91 Cal., 432, 24 Pac., 864, 27 Pac., 756.

Regarding general election designated as special election, reference is made to Att'y-Gen. v. Trombly, 89 Mich., 50, 50 N. W., 744.

"Whether or not the publication of an election notice was duly made is a question of law for the court." P. v. Voorhees, 187 N. Y., 327, 80 N. E., 196. Lancaster Intelligencer v. Lancaster County, 9 Pa. Dut. 392.

"There can be no remedy by quo warranto in contesting an election on a proposition, for that remedy is employed only to test the right to an office or franchise." 15 Cyc., p. 394, with references to People v. Grand County, 6 Colo., 202, and People v. Whitcomb, 55 Ill., 172.

Again, "specifications of mere irregularities not affecting the result of the election will be stricken out on motion," with references to Mann v. Cassidy, 1 Brewst (Pa.) 11; Matter of District Attorney, 2 Phila. (Pa.) 199; Kneass' Case, 2 Pars. Eq. Cas. (Pa.) 553; Brightly Lead. Cas. El., 260, 337.

Unless there is some Missouri statute which is directly applicable some of these cases should have considerable effect. Possibly some help can be obtained from State v. Westport, 116 Mo., 582, 22 S. W., 888, and Hayward v. Guilford, 69 Mo. App. 1.

Can City Ordinance Make Usury a Misdemeanor?

I have recently been requested to draft an ordinance for the city making the charging of usurious rates of interest a misdemeanor. The legal rate of interest in this state is 8 per cent. Do you know of any city having such an ordinance, and if so, can you procure a copy of the same for me.

J. W. W., City Attorney, ———, S. C.

The writer knows of no city in which this subject is covered by a city ordinance. Indeed, the matter seems to be one properly regulated by statute and violation of the statute is punishable under the state law so that it should not be necessary for the city to attempt to govern practice. Can any of our readers refer us to such a city ordinance?

Information About Small Water Works.

Could you give me any information regarding the installing of waterworks in small villages of about 1,200 people? We would like to know the cost of cast iron piping and the cost of excavation, cost of stand pipe, and pumps. We have a good waterpower for the drive, and good high point to build a stand pipe. Any information you can give us would be greatly appreciated, or if you have a book that would help us. We have to lay about 1 mile of pipe 4 to 5 feet deep.

L., Village President, ———, Mich.

A good book on this subject is Goodell's "Water Works for Small Cities and Towns" ($3). Cast iron pipe costs at present $24.50 to $26.50 per ton in Chicago. It will probably be safe to estimate the cost of 4-inch pipe at 50 to 60 cents a foot, including pipe and laying, and 6-inch pipe at 70 to 80 cents. Capacity of pumps and standpipe, kind selected and design of system so influence cost that no close estimate can be made on the data given. It is quite possible to bring the cost of the whole system to $10,000 or to spend $20,000 on it if desired. Expert engineering assistance in designing the plant and constructing it will be worth its cost.

Rates for Water.

Kindly give me, a subscriber, the following information: (1) average number of gallons of water used for family use per day; (2) average daily consumption allowed for all purposes in a city of (a) 7,000, (b) 10,000, (c) 12,000, where there are no unusual demands for manufacturing purposes; (3) annual rates in cities of the sizes above mentioned for kitchen sink (hot and cold), basin (hot and cold), bath (hot and cold), water closet.

I would like to have reference to works (with addresses of publishers) on the above subjects. I would like also to know the usual practice in the segregation of rates; that is, the basis on which rates are divided between family uses, municipal uses and industrial uses.

A. E. K., ———, Pa.

Turneaure and Russell's "Public Water Supplies" ($5) gives much information on this subject. The consumption per person for domestic purposes varies in cities in Massachusetts using meters, from 11.2 gallons a day in Fall River to 43 in Brookline. The ordinary allowance is 20 to 30 gallons. When supplies are not metered the consumption is ordinarily larger, in small cities not much larger, but in large cities often several times as much. In cities of the sizes named the consumption, where all services are metered, may be as low as 40 to 50 gallons per person, per day, of which 40 per cent. may be unaccounted for loss or leakage, or it may be as high as 130 gallons with few or no meters. There are so many variables besides population that there would be no difference in the estimate of consumption for cities of no greater differences in population than those given. In a table given in the book referred to consumption in 1890 varied in the cities below 13,000 population named in it from 21 to 90 gallons per person daily in 1890. In 1905 the consumption in the same towns had increased so that the variation was from 35 to 130 gallons per person daily. In another table are given averages for six years in Massachusetts cities, which, in cities of less than 13,000 population range from 36 to 89 gallons per inhabitant daily.

Goodell in his "Water Works for Small Cities and Towns" ($3) estimates 50 to 60 gallons per capita daily in a city of 20,000 population with many towns to be sprinkled in summer and 40 gallons for a mill village of say 10,000 population, in

which cases the amount necessary for fire protection would govern size of pipes and amount of supply.

The "Manual of American Water Works" for 1897 ($3) gives a long list of rates for water reduced as nearly to comparable form as is possible. The family rate in the table is assumed to cover the kitchen sink with cold or both hot and cold water and in many towns and cities is proportional to the number of persons in the house, the number of rooms, the front width, etc. Following are ranges of rates per year selected from this table for towns in Pennsylvania:

Family rate, $3 to $13; wash bowl, 0 to $2.50; bath tub, 2 to 6; water closet, 1 to 5.

In addition to the above books reference may be made to several volumes of the proceedings of the American Water Works Association, the transactions of the American Society of Civil Engineers, the Journal of the New England Water Works Association, the volumes of MUNICIPAL ENGINEERING, *Engineering News*, *Engineering Record*, etc.

Books on Town Planning.

Can you recommend a reliable book on the subject of Town Planning? I would like something treating the subject from the legal and legislative standpoint, as well as from the view of a surveyor.

G. G. M., St. John, N. B.

"An Introduction to City Planning" ($1), by B. C. Marsh, discusses the subject from the points of view of the congestion of population, the physical factors in city planning, legislation, building codes, the technical places, and the methods used in securing city plans. He also has a bibliography on the subject, covering most of the publications of recent years. Practical examples will be found in the reports on various cities, some of which are in his list, and some are later. Among the latest are Robinson's "Better Binghamton" ($1.25), and Nolen's "San Diego," which can probably be obtained for the same price.

The "Proceedings of the Third National Conference on City Planning" is a book full of excellent material on all phases of the subject.

A very valuable publication in this line is "The Town Planning Review," published by the University of Liverpool, England, quarterly, which can be obtained for about $3.50 a year.

What City Has Set of Instructions to Inspectors?

We are anxious to compile a set of instructions to street paving inspectors. Could you advise us in regard to any cities you may know of, that publish instructions which might be used as a model or guide in formulating such a set.

H., Engineer of Streets, ———, N. J.

Will our readers send us copies of such instructions to inspectors of any sort which they may be using, no matter how brief or how lengthy? They will be published if permission is given. The only help in this line known to the writer is Byrne's "Inspectors' Pocket Book" ($3), which covers materials and workmanship in construction, but would probably be supplemented by special instructions by each engineer requiring its use.

Book on Piers and Abutments.

I wish to obtain a good book on design and construction of highway bridge piers and abutments. Can you refer me to something in this line?

E. R. W., Parham, Mich.

Fowler's "Ordinary Foundations" ($3.50) is probably the fullest treatment of this subject. There is a chapter in Ketchum's "Design of Highway Bridges" ($4) and chapters on the subject will also be found in Baker's "Masonry" ($5). These books can be furnished at the prices named.

Information About Imhoff Tanks.

Please inform me if there are any books on Dr. Imhoff's method of sewage disposal.

R. H. G., Oakland, Cal.

The method has not yet reached the textbooks, for, although the tanks have been in use some years they have not become prominent in the minds of engineers until they were taken up by some well known American engineers and fully described and their construction promoted by them. The latest edition of Folwell's "Sewerage" ($3), has a very brief description of the tanks in connection with others. There is a like brief description in Easdale's "Sewage Disposal Works" ($4). Each has sectional drawings of an installation.

Ohio Sewers Built by Order of State Board of Health.

Please advise in Question Department, what if any towns of about our size (4,000) have been commanded by our State Board of Health to build sewer systems (as we understand they have the power to do), also with any available information as to what was built with conditions or circumstances that affected the case if known. Also I would like to learn of any towns near us that have sewage disposal.

C. E. VAUGHN, East Palestine, O.

So far as the writer knows there is no municipality in Ohio which has built a sewer system under Bense Act giving the State Board of Health the power to order such construction and enforce its order. An attempt to enforce such an order at Greenville has resulted in a decision by the circuit court of Darke county, that the law is void because it excepts certain cities from its provisions. The point has not yet been passed upon by the State Supreme Court.

Sewage disposal plants near Columbiana county are located at Alliance and Canton. Plants at public institutions at Alliance, Massillon, Morgans, Warren are near at hand.

FROM WORKERS IN THE FIELD

Practical Points from Practical People.

Contributions to this Department are invited.
Give from your experience for the benefit of others.
Never mind style of composition, the fact is what is wanted.

Coal Tar for Paving Purposes.

To the Editor of MUNICIPAL ENGINEERING:

Sir—I notice in Mr. Clifford Richardson's teresting letter on the subject of the "Characteristics of Bituminous Highway Materials" in the January number under "From Workers in the Field," the statement that "Coal-tar pitch has no value for paving purposes." I should like a little further information as to why coal tar is not useful for paving purposes.

GEORGE E. SMITH, Civil Engineer,
New Haven, Conn.

This letter was referred to Mr. Richardson, who makes the following reply:

To the Editor of MUNICIPAL ENGINEERING:

Sir—In reply to your correspondent's inquiry for a little more information as to why coal tar is not useful for paving purposes, I would say that this has been proved by service tests extending over more than half a century. It is due to the fact that coal tar is not, in the first place, a material of any uniformity.

In the second place, it is a product of an industrial process which cannot be carried on with great uniformity; and third, it is a material which becomes so altered with age that after a certain length of time it loses its cementing properties and becomes quite brittle. In order to use it at all satisfactorily it must in the first place be of such a consistency that it makes a very soft surface and one very susceptible to the hot summer sun. It has been used more successfully in connection with coarse mineral aggregate where such a soft material could be used without unpleasant results. In this connection the following statement of Mr. A. Brown, of Nottingham, England, may be of interest to your correspondent:

"There is nothing on earth which differs so greatly as the liquid called tar. Good and poor qualities of tar are quite common and chemical analysis so far does not always help you, and besides the analysis of tar is rather an expensive matter, and unless you have every load analyzed you are not certain, and this analysis would add 50 per cent. to the cost of your material. Tar varies in quality at different gas works, hence the futility of giving prescriptions of 'so much tar to so much pitch,' which in another town, buying tar from another gas works, would cause failure.

"But the same thing applies to tar from any works, it differs at the same gas works at different seasons of the year. The tar from one gas works is quite different to the tar from another works in the same town. A different method in carbonizing the coal, using a lower grade of coal, and very often a change in the management alters entirely the nature of the tar and renders it unsuitable for tar-macadam purposes."

CLIFFORD RICHARDSON,
Consulting Engineer,
New York City.

Bituminous Roads.

To the Editor of MUNICIPAL ENGINEERING:

Sir—The writer has been much interested in paper on the above subject by Maj. W. W. Crosby, C. E., before the convention of the American Association for Highway Improvement.

The writer most heartily endorses Maj. Crosby's statement "There is no one "best way" and no one "best material.'" The decision as to method or material to be used must depend in each case upon conditions of traffic, etc. It has been the aim and effort of the writer and his business associates to develop methods of construction of varying costs to meet such varying conditions but always confining development to strictly first class construction and to avoid everything of the nature of makeshift.

Maj. Crosby well says "The first cost of bituminous roads is not a correct basis for the proper comparison of either materials or methods." Perhaps the most extensive and recent development forcibly illustrating the futility of adopting cheap "makeshift" method of construction is in Los Angeles County, Cal., which during the past two years has expended $3.500,000, in "penetration" and "surface" treatment with the result that at the Santa Barbara convention of the California League of Muni-

cipalities in October, 1911, the consulting engineer of the Los Angeles County Automobile Association stated that practically all the county has left for this large expenditure is the experience that this expenditure of millions has been wasted. The Los Angeles Times of October 7th, 1911 comments as follows on the Los Angeles County highways.

"As the result of a thorough and searching inquiry into the roads and highways situation in Los Angeles county, the grand jury yesterday returned a partial report setting forth that the oil macadam type of road construction which has been in general use in the highway building under the $3,500,000 bond issue cannot be considered otherwise than as a failure."

To the Editor of MUNICIPAL ENGINEERING:

During the past few years Maj. Crosby as chief engineer of the Maryland Roads Commission has earnestly endeavored and worked to secure satisfactory road construction at low cost. The writer is one who believes, independent of his commercial interest, that it is poor economy to adopt a form of construction to meet modern automobile traffic which is not strictly first class and which does not recognize the fact that utility is of far greater importance than first cost even though the adoption of such strictly first class construction may necessitate the use of "expensive machinery not to mention freedom from interference by patent infringement claims."

Is the avoidance of a reasonable return to the inventor under a patent franchise granted by the Government in accordance with the Federal Constitution a valid reason for turning to an inferior or questionable form of construction?

It is of especial value to note Maj. Crosby's conclusion that the mixing method costs from "30 cents to $1.50 per square yard over and above what would have been the cost of an ordinary water bound road under the same conditions." In other words, if an ordinary water bound macadam road costs say $1.00 per square yard then the cost of a strictly first class bituminous road may be as high as $2.50 per square yard.

Maj. Crosby says he "is unable to wholly agree with a statement that has been made elsewhere to the effect that 'the water bound road is a thing of the past.'" The writer believes that when this statement has been made it is generally, if not universally coupled with a statement of the additional factor "as a road which will successfully withstand the ravages of modern automobile traffic." That Maj. Crosby had this in mind, although he did not state this factor to the proposition, is shown by his further statement of a supposed case where "as soon as the road is completed a considerable number of motor vehicles will use the road daily, say not less than twenty every twenty-four hours. Then there is no question but that the road should be treated with bitumen." The writer would class a road carrying less than twenty automobiles in twenty-four hours as not subjected "to the ravages of modern automobiles traffic," and that such a road practically is confined to the problem which confronted John Macadam, and the water bound road invented by him would doubtless resist such traffic practically as well as the macadam roads built prior to the advent of the automobile, only about twelve years ago. Even under such conditions, however, there remains the serious question "All things considered, is not the adoption of high grade modern bituminous road surface justified by its greater utility, comfort, freedom from dust and other advantages even though the first cost is much higher?"

Suppose the answer is to be in the affirmative, there still remains the question that many communities have not yet made financial arrangements such as to make such modern construction possible at present and in such cases they must for the present be content with the best they have the money to buy and depend on future appropriations for providing a modern high grade bituminous surface.

GEORGE C. WARREN,
Boston, Mass.

Granite Pavements in Manhattan.

To the Editor of MUNICIPAL ENGINEERING:

Sir—The recent article by Mr. Ernest Flagg on Stone Pavements of England and America, taken from the *Century Magazine*, contains an interesting, although incomplete description of the Liverpool stone pavements. The description of the New York City stone pavements is, however, so misleading as to call for a statement of the situation as it actually is and the conditions which have led up to it.

The author of this paper states that the stone pavements in the borough are made of what are called Belgian blocks. There are in fact, 89 miles of granite block pavement and about 17 miles of Belgian block stone pavement. The Belgian blocks are small trap blocks of a truncated pyramid form. They are laid on sand with the small end down. No blocks of this type have been laid in the borough for twenty-five years except a few experimental ones at the intersection of Broadway at Canal St., which were imported, laid in concrete with grouted joints and gave good service.

The size of the granite blocks used in the borough has been 3½ to 4½ inches wide, 8 to 12 inches long and 7 to 8 inches deep. The author has exaggerated the size

of the blocks, as they will average well under the maximum limits prescribed. No granite pavement has been laid on sand without a concrete foundation for more than twenty-five years in Manhattan, except repairs. The quality of the concrete foundations has been much better than the author would seem to think, as the writer can testify from personal observation. He has found no case where the pavement failed because of faulty foundation and has found very numerous instances where the concrete was in excellent condition after several years service, although not laid under ideal conditions.

Curbs. The curbstones are very frequently laid by the municipality. Indirect permission is at times granted to owners erecting large office buildings or elaborate structures to lay a more substantial or costly curb than the city would be warranted in laying. The curb laid in Manhattan is of bluestone five inches thick and tests have shown that its crushing strength is greater than that of granite. When dressed smooth it presents a better appearance than granite because it matches in color the sidewalk materials. The Liverpool curbs are one inch thick, which adds to the substantial appearance of the street but not necessarily to the life of the curb. The author fails to point out the real reason why our curbs are not in satisfactory condition, which is that they are not to any great extent set in concrete as they undoubtedly should be to assure permanency of line and grade.

Crosswalks in this borough are almost entirely of the hardest and toughest granite and compare very favorably with Liverpool stones. The greatest defect they have is in not being dressed to a smooth surface.

The author's description of what happens when the joints of a granite pavement are poured fails to agree with the writer's, who has had opportunity for observation of pavement conditions in the borough of Manhattan for twenty-five years. The pitch or paving cement almost invariably reaches the bottom of the block, If it does not do so at once it will after a hot summer. I have seen many trenches cut in granite pavement and find it a rare thing when the conditions are not as described.

Rocking blocks are also a rarity and invariably indicate defective work.

The author's criticism that the joints of paving work are too wide is certainly in accordance with the best practices. The writer desires to direct attention to a discussion (see Transactions Am. Soc. Civil Eng'rs., vol. lix, p. 336, July 10, 1907) by Mr. Geo. W. Tillson, formerly Chief Engineer of Highways, Borough of Manhattan, for the purpose of showing that the Liverpool pavements have been familiar to city engineers for a long time. Mr. Tillson says: "It is admitted by all that the first-class streets of Europe are better than streets of a similar class in America. The difference is in the blocks themselves. They are better dressed and more uniform in size. * * * Granite as it is used becomes smooth and consequently slippery. This can be helped by making the blocks smaller; and if they are well dressed, they can be set closely together and so make it practicable to fill the joints with a bituminous paving composition alone without gravel." The author assumes that the prevalent British practice in stone paving is unfamiliar to New York City engineers. The above remarks by Mr. Tillson indicate that the construction was familiar for four years at least before he made his discovery. Mr. H. Percy Boulnois in 1895 published his "Construction of Carriageways and Footways" containing the original of Mr. Flagg's diagrams and a complete description of the Liverpool pavements. This book has long been familiar to city engineers.

Regarding the traffic the author fails to state that wide tires are the rule in Liverpool and also to give any figures of the amount of traffic in tons per foot width of street and above all fails to state that the amount of street opening is insignificant compared with those made on any heavily traveled street in Manhattan.

Traffic statistics based on observations taken on Jan. 23, 1912, 10 hours per day, show on Broadway, between Leonard and Franklin Sts., a traffic of 137.6 tons per foot of width. Street has a double line of tracks but is considered as one roadway. Granite paved.

That there are many more influences in the borough of Manhattan which tend to destroy granite pavement there can be no question. Among these may be mentioned numerous openings, narrow tires, fire burns, etc., all of which tend to increase the maintenance cost and have been active influences in deterring the city authorities from taking up a more expensive type of stone paving such as the author suggests. That the time is now ripe for the adoption of a smooth granite pavement, whatever its cost may be, there can be no question. The improved granite pavement (⅝-inch joints) recently laid on Fourth Ave., between Eighth and Twenty-Third Sts., cost about $3.55 a square yard including a six-inch concrete base. A smooth granite such as that had in Liverpool will probably cost between $5.00 and $5.50 per sq. yd. in New York City, which is so high as to be under the circumstances, almost prohibitive.

DANIEL B. GOODSELL,
Assistant Engineer, Department of Public Works, Borough of Manhattan, New York City.

Proposed Method of Treating Wood Paving Blocks.

To the Editor of MUNICIPAL ENGINEERING:

Sir—I herewith enclose a copy of correspondence between myself and Mr. Cherrington. The subject matter I think is of great interest to the municipalities using treated wooden blocks for street paving.

I suggested during the convention of the Association for Wood Preserving, held in Chicago recently, that every engineer representing a city using treated wooden blocks for street paving be requested to lay down a sample pavement, no matter how short or long, treated with an oil having a heavy asphaltic base. GEO. A. SCHILLING.

Pres. Board of Local Improvements, Chicago, Ill.

Mr. Frank W. Cherrington, care Indian Refining Co., Cincinnati, O.

Dear Sir—We have had considerable trouble with the creosoted block pavements laid in this city because of expansion and bleeding, and we have changed our specifications from the oils used this year to a lighter oil.

I send you under separate cover a report just issued by this city, made by John Ericson, our city engineer, with regard to the heavy oils that have been used for the past two or three years. It is contended in some quarters that the heavier oil is not only a preservative, but a water proofing oil, but by the report which I send you you will note that many of the blocks have not been penetrated with this oil, and the swelling which we noticed would indicate that it does not waterproof.

The question arises whether we could not treat blocks with the thinner oil and secure a thorough penetration, say with about twelve pounds to the cubic foot, and then charge the cylinder with a heavy oil with an asphaltic base and inject six pounds additional into the block. While this second treatment would probably not penetrate the block it would do so sufficiently to seal it and thereby waterproof it. This conclusion has been forced upon me by reason of the fact that tar, which is an important element in the heavy oils heretofore used, melts at about 110 F., whereas asphalt does not melt until it reaches about 220 to 240 F. It is claimed that the heat of the sun during the hot days of last year registered 140 on the surface of the street and it is therefore not surprising that the tar was drawn to the surface of the blocks.

It was suggested that I take this matter up with you as you had likely been carrying on a number of experiments along this line. Have you ever tried it thus, and if so, what were the results?

As the wood block manufacturers will have a convention in the Sherman House in this city on January 16 I would like to know whether you will be there.

Thanking you for any information on this matter, I am, Very truly yours,

(Signed) GEO. A. SCHILLING,
President.

Cincinnati, O., January 3, 1912.

Geo. A. Schilling, Pres. Board of Local Improvements, City of Chicago, Ill.

Dear Sir: I have your letter of the 22d instant, relative to the adaptability of our timberasphalt as a seal in a two-stage injection of say 12 lbs. creosote, and 6 lbs. residual oil (timberasphalt) per cubic foot on wood block for pavement.

We have carefully noted the contents of your letter and the circular or report made by your city engineer, regarding the use of heavy creosote employed in your specifications for the past three years. We are reasonably certain that the treatment in the way you suggest would prove the means of preventing the expansion of the treated wood block paving, due to the absorption of moisture after treatment, and at the same time preventing the bleeding of the oil from the blocks in hot weather.

The only tests we have regarding this most important factor of expansion and buckling of the treated blocks are laboratory experiments upon blocks first treated with 16 lbs. of creosote per cubic foot and then followed by an injection of 6 lbs. of residual oil (timberasphalt).

Blocks so treated stood up under the tests generally given creosoted blocks for waterproofing as follows: The blocks were first dried in an oven at a temperature of 120 degrees F. for a period of 24 hours, weighed, and then immersed in clear water for a period of 24 hours. The gain in weight was found to be 0.02 of 1 per cent. Almost every city has a clause in their specifications which states that a block treated with 20 lbs. per cubic foot of creosote, subjected to this same test, shall not gain more than 3 or 4 per cent. in weight.

The same test was made on blocks treated with straight residual oil (timberasphalt) at 16 lbs. per cubic foot, and showed the same result, proving that the water did not get past the penetration secured by the injection of the 6 lbs. per cubic foot in the two-stage treatment.

The writer expects to be in Chicago for the Wood Preservers' Association this month, and will at that time take pleasure in calling upon you to go into the subject more thoroughly.

No doubt it would be easy to arrange several tests in the experimental cylinders of the commercial plants who have been treating your blocks for you in the past, in order to bear out the assertions we have made regarding our own laboratory tests with residual oil (timberasphalt).

If you are anxious to take up this matter before the convention the middle of this month, kindly advise in order that I may arrange to see you in the near future.

Very truly yours,
THE CINCINNATI WOOD PRESERVING CO.,
(Signed) Frank W. Cherrington,
Gen. Mgr.

Cities Owning Their Asphalt Paving Plants.

To the Editor of MUNICIPAL ENGINEERING:

Sir—On page 117, of your February issue, we find a question from D. B. G., New York City, asking for a list of those cities in the United States which have (own or operate) municipal asphalt plants. In going over the list we do not find that we have credit for one of our portable plants which has been in use by the city of San Antonio, Tex., for the past three or four seasons. This plant is in charge of Wm. J. Mortimer, superintendent.

We find also that Toledo, O., is marked as "repair plant," whereas we sold them one of oud small size portable plants, which will be installed early in April.

THE EAST IRON AND MACHINE CO.
Lima, O.

Further corrections or additions to the list are requested that it may be made as complete and accurate as possible.

Recent Progress in the Good Roads Cause.

(Continued from p. 127, February number.)

PHILIPPINES.

Between 1901 and 1910, over $12,000,000 were expended on roads in the Philippines. Of this sum $2,724,067 were from relief funds appropriated by the U. S. Congress, $4,060,611 were from revenues of the general government of the Islands, $358,584 from proceeds of bonds issued by the same, and $5,010,678 from provincial funds.

The government funds are distributed to provinces which increase their taxes by certain amounts for road purposes and place the construction of their roads and bridges under the central bureau of public works, in proportion to the total population of the provinces accepting the provisions of the act. Maintenance under the act requires at least one patrolman for each kilometer of road in the wet season, five months, and for each two kilometers in the dry season, and the supply along the roads of at least 50 cubic meters for each kilometer of gravel or broken stone, according to the material of which the road is constructed.

A system of roads has been laid out, consisting of first-class roads with substantial foundations, good drainage, durable and continuous surfacing, and permanent bridges and culverts; second-class roads, partly surfaced and of width and light grade permitting passage of light traffic for entire length; and third class roads, narrow, passable with difficulty by light traffic, or even pony trails. The first-class roads already constructed will be extended and connected together as rapidly as possible.

There is a permanent appropriation of 500,000 pesos a year for road construction and maintenance, with other special appropriations, in addition to the local provincial funds. The total of these funds for the fiscal year 1910 amounted to about 6,000,000 pesos.

The length of first class roads increased from 395 kilometers in 1908 to 914.6 kilometers in 1910. The patrol system of maintenance was established on the whole of the first class roads, and on about 2,000 kilometers of second-class roads. The mountain trails and part of the second-class roads are maintained by what is called the gang system. The cost of the patrol system was somewhat more than 500,000 pesos in 1910. Prizes are awarded to various provinces from the general government funds of 10,000 pesos each for the best maintained and most complete system of first-class roads; the greatest expenditure for roads in proportion to total revenue; and for the most complete and best maintained system of second-class roads. Individual prizes to members of the provincial maintenance organizations are also made.

The roads are under the Secretary of Commerce and Police, the organization including the advisory committee of the director of public works, two appointees from that bureau and two from the executive bureau; the director of public works, who is in charge of all construction work; the inspection force of a general road engineer and four division engineers; and the construction force of district engineers, assistants and superintendents.

PORTO RICO.

Prior to 1910, 977.4 kilometers of good roads, suitable for motor vehicles, had been constructed in the interior of Porto Rico, at a cost of about $7,000,000. The cost of maintaining these roads, estimated at about $300,000 a year, takes about all the available annual funds. However, a loan of $425,000 and a direct appropriation of $170,000 was made for construction purposes under an act authorizing the use of convicts, with the expectation that this system would be possible to maintain with the funds regularly available. A small part of this sum will serve to close gaps in the coast line around the island and the majority can be used on the roads of the interior.

The Governor of the island has general charge of the roads.

Porto Rico has a population of 1,118,012, and its 68 counties range in population from 1,000 to 63,000.

RHODE ISLAND.

The good roads law in Rhode Island was adopted in 1902. John H. Edwards is chairman of the State Board of Public Roads. The roads are constructed and paid for by the state. Including 1910, $1,898,910 had been so expended.

The revenues of the board for 1910 included appropriations of $5,000 for office and traveling expenses and $30,000 for construction; $66,056 from automobile licenses; and for state highway construction, $300,098 balance on hand at the beginning of the year, and $17,957 received from towns. The revenues for 1911 were about $97,000. The mileage constructed in 1910 was 36.5 miles.

A law passed in 1910 provides that any

town appropriating at least 20 cents per $100 of taxable property for road maintenance and repair, under the care and direction of the state board of public roads, may receive from the state one-fifth the resulting amount for addition to the town's fund. But one town took this action in 1910, and asked the legislature to make the appropriation, $1,240, to make the law effective.

The state board made, at one time, a plan for a complete network of good roads, connecting all the counties and the important towns and the cities of the state, under a law authorizing $600,000 for the construction. Some of this system has not yet been constructed although the board recommends appropriations for the purpose in each of its annual reports. The legislature, however, has added numerous other roads to the system, without much, if any, reference to their value or adaptability thereto, and has made appropriations for their construction until the road map of the state now shows some very peculiar plans, not to be understood unless the political nature of the selection of the routes is explained.

The state board now has 250 miles of state road under its supervision.

The total mileage of improved roads in the state in 1909 was 2,120.75, of which 1,042.07 miles have been improved, which is 49.14 per cent. of the total mileage. Of these improved roads, 21.97 miles are bituminous macadam, 409.1 miles are stone, and 605 miles are gravel, of which latter 6 miles appear to be sand-clay. There was an increase of 5.87 per cent. in the proportions of improved roads, between 1904 and 1909. The percentage of improved roads to the total mileage varies in the counties of the state from 17.54 in Kent county, to 61.25 per cent. in Providence county.

Maintenance of roads cost $68,148 in 1910, and $80,000 in 1911.

The county board has 3 to 7 members. The town council has charge of the highways in the towns, and divides the town into 4 or less districts, with one surveyor appointed for each district.

The population of Rhode Island is 542,610, and it increases about 25 per cent. per decade. Its five counties range in population from 18,000 to 39,000, with Providence county 424,000.

The Minneapolis Wood-Paving Experiments.

Forest Service Circular 194 of the U. S. Department of Agriculture describes the experimental wood pavement laid in Minneapolis, referring to Circular 141 for more detailed description, and also the condition of the pavement in August, 1910, when inspected by a committee including Francis M. Bond in charge of the wood preservation section of the U. S. Forest Products laboratory, the author of this circular. Measurements were taken of wear, depressions, etc., but the general conclusions are that no more definite comparisons of the different kinds of wood can be made than their arrangement in the order of their value; viz., (1) long leaf pine; (2) Norway pine, white birch, tamarack, eastern hemlock; (3) western larch; (4) Douglas fir. The Douglas fir sections were so badly worn that they were relaid with better timber of the same kind in June, 1911.

Travel records and analyses and specifications for oils used in treating blocks are also given in the circular.

Length of Improved Roads in the United States.

After an investigation extending over many months, Logan Waller Page, Director of the Office of Public Roads, has ascertained that there are now 2,199,645 miles of public roads in the United States. The figures include all the new roads built up to the year 1909. In 1904 there were exactly 2,151,379. It is apparent, therefore, that the increased mileage of new roads within a period of about five years has been 48,266.

In summarizing the results of this investigation Mr. Page says:

It is interesting to observe the growth of improved methods in road construction. For instance, the total mileage of stone roads in 1904 was 36,818, while in 1909 it was 59,237. The total mileage of gravel roads in 1904 was 109,905, while in 1909 it was only 102,870. This decrease in gravel roads, however, was due to a reclassification of roads. Many of those reported in 1904 to be of gravel proved to be of some other substance, while exaggerations were eliminated.

The percentage of roads which were really improved, amounted to 7.14 in 1904, while in 1909, to which year statistics are now available, the percentage was 8.66.

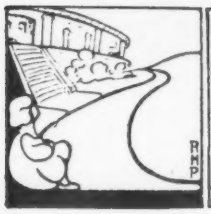
The total mileage of sand-clay, brick, bituminous-macadam and other improved roads in 1904 was 6,806, while in 1909 the mileage reached 28,372.

The circular contains a table showing the mileage of improved roads, the following states having the largest mileage:

	1904.	1909.
Indiana	23,877	24,955
Ohio	23,460	24,106
New York	5,876	12,787
Wisconsin	10,633	10,167
Kentucky	9,486	10,114
Illinois	7,924	8,914
California	8,803	8,587
Massachusetts	7,843	8,463

Portland Cement Manufacturers.

The 1912 edition of the *"Directory of Portland Cement Manufacturers,"* which also includes the manufacturers of gypsum and lime, has been received. The list of companies gives names of officers, capacity, process and other like information. The officers also appear in an alphabetical list, which includes chemists and superintendents. There are alphabetical lists of brands, of officers of societies, and a buyers' guide. The little pocket book of 250 pages is published by the *Cement Era*, Chicago, Ill., and can be obtained for $1.



ORGANIZATIONS & INDIVIDUALS

Indiana Sanitary Association.—Clay Products Show.—Illinois Water Association.—Technical Associations.—Calendar.—Technical Schools.—Civil Service.—Personal Notes.

Indiana Sanitary and Water Supply Association.

The Indiana Sanitary and Water Supply Association held its fifth meeting in Indianapolis, February 15 and 16. Under the fostering care of the Indianapolis Water Company and the State Board of Health, which has provided excellent programs for all its meetings, the association has increased rapidly in numbers and in the interest which it has excited among the water works men of the state. The only criticism of the program was that it was too extensive for the time allotted to it, there being sixteen papers and fourteen formal discussions of the same scheduled for the three regular sessions of the convention, besides two luncheons and a banquet with their attendant speeches and an evening address at a joint meeting with the Indianapolis Commercial Club. There were very few failures to appear. The character of the papers presented may be judged from those printed in this number of MUNICIPAL ENGINEERING, and others that will appear later.

The subjects treated included sanitary surveys of rivers, beautifying streams, purification of water and sewage, well supplies, public utility commissions, fire protection, and water works and electric light plant management. Besides the experts from Indiana, there were present in person or by paper or discussion, Paul Hansen and Edward Bartow, of the Illinois state water survey; George W. Fuller, consulting engineer, New York; Charles B. Burdick, consulting engineer, Chicago; Dr. W. J. McGee, of the U. S. Department of Agriculture; Prof. Halford Erickson, of the Wisconsin Railroad Commission; T. C. Phillips, in charge of the Chicago water waste survey; and Dabney H. Maury, consulting engineer, Peoria, Ill.

Frank C. Jordan, of the Indianapolis Water Company, was re-elected president; Dow R. Gwin, superintendent of the Terre Haute Water Company, H. E. Barnard, state pure food and drug commissioner, C. S. Woods, city sanitarian of Indianapolis, J. W. Elms, superintendent of the Cincinnati water filtration plant, and J. W. Peck, of the Evansville city water works, were elected vice-presidents; and Dr. W. F. King, assistant secretary of the state board of health, was elected secretary-treasurer.

Municipal Displays at the Clay Products Show.

By reason of the municipal features of the Clay Products Show at the Coliseum in Chicago on March 7-12, Mayor Harrison has extended a personal invitation to the mayors of the United States and Canada to attend the exposition. The entire Annex of the Coliseum has been set aside for the municipal display. This will include a demonstration of correct practice for below-level street construction and sewerage system. A $10,000 sewerage ditching plant will be installed by the Austin-Western Company on a full width city street, and from this a complete line of vitrified sewer pipe will be run to a portion of a public comfort station installed by Wolff Brothers, the owners of the Montezuma Pottery Co., at Trenton, N. J. Alongside of the sewer line will be laid a line of electric wire conduits, and on the opposite end of the street will be demonstrated the perfection of brick paving, showing the construction of the base and the various phases of the work of surfacing. A complete street will be demonstrated, showing the sanitary value, and permanence of brick paving. The block used will be the Wire-Cut-Lug type, which is now being manufactured by eleven prominent paving brick companies.

Connected with this display will be indivual displays of various sewer pipe manufacturers and paving brick manufacturers, extending down both sides of one aisle on the main Coliseum floor. Other paving block plants in the country will be represented in this exhibit, which is under the auspices of the National Paving Brick Manufacturers' Association. Included in the exhibit will be a large size model brick street, showing correct methods of paving under "No. 1 specifications." Various demonstrations of brick testing will also be made at the exposition, and many other features of municipal interest.

Perhaps the chief value of the exposition to municipal authorities will be in the visible demonstration of modern fireproof construction methods. In fact, the show is largely promoted for the purpose of demonstrating to the public the necessity of fireproof construction, and the methods by which burned clay materials can be used for fireproof business blocks, factories and residences.

This feature of the exhibit is so important that it has been given the endorsement of the fire marshals and building inspectors of many cities throughout the country, and it is believed that the attention given to the subject will result in greater interest in the revision of the building codes.

A number of societies will meet during the convention. One of the most important conventions to be held at that time will be that of the National Brick Manufacturers' Association. This organization includes the manufacturers of common building brick, facing brick, ornamental brick of all kinds, paving brick, fire brick and refractories, gas retorts, crucibles, glass furnaces and furnace linings, hollow block, sewer pipe, conduit for underground wiring, farm drain tile, silo blocks, fireproof hollow tile for skyscrapers, building terra cotta, architectural terra cotta, faience for interior work, floor and wall tile, mosaics, pottery, sanitary ware, semi-porcelain, chinaware, art pottery, kitchen ware, clay pipes, clay pigeons, marbles and electrical insulators.

The American Ceramic Society, the technical organization of the clay industry, will also meet in annual convention there. This society ranks with the British Clayworkers Institute, and is made up of scientists and college professore.

The National Paving Brick Manufacturers' Association is another organization scheduled to meet in Chicago while the Clay Products and Permanent Home Exposition is being held at the Coliseum from March 7 to 12. This association represents twenty-five million dollars capital and concerns itself with the manufacture of block for the surfacing of city streets and country highways.

The Building Brick Association of America, another name in the list of conventions, is an organization comprised of the advertising men connected with the brick industry. Members of this association spend $50,000 annually in advertising.

Other organizations to meet are the Association of Manufacturers of Clayworking Machinery, representing twenty million dollars invested capital; the Western Drain Tile Bureau, with a membership of 2,000 manufacturers; the Illinois Clay Manufacturers' Association and the Wisconsin Clay Manufacturers' Association.

The Illinois Water Supply Association.

The Illinois Water Supply association will hold their annual meeting at the University of Illinois, Urbana, Ill., on March 5 and 6, and a very interesting program has been outlined. Papers on water purification, sterilization and on filtration plans will be presented by W. M. Cobleigh, professor of chemistry, Montana State Agricultural College; Dr. W. M. Cross, city chemist, Kansas City, Mo.; W. W. DeBerard, western editor; Dr. Arthur Lederer and Frank Bachman, sanitary district of Chicago; W. Lee Lewis, professor of chemistry, Northwestern University. Waterworks and pumping problems will be discussed in papers by R. A. Gabbert, Mattoon, Ill.; E. MacDonald, superintendent Water and Light Co., Lincoln, Ill.; H. Ruthrauff, commissioner of public property, Decatur, Ill.; W. J. Spaulding, commissioner of public property, Springfield, Ill.; M. M. Symons, chief engineer, Danville Water Co., Danville, Ill.; H. A. Stevens, city engineer, Joliet, Ill.; and C. C. Young, chemist, Kansas State Water Survey. Paul Hansen, engineer Illinois State Water Survey; Dr. J. A. McLaughlin, United States Public Health and Marine hospital service, Washington, D. C.; and H. N. Parker, bacteriologist, University of Illinois will discuss the relation of impure water supplies to typhoid fever.

Technical Associations.

At the annual meeting of the American Road Builders' Association, held February 2, in New York, N. P. Lewis, chief engineer of New York board of estimate and apportionment, was elected president; Harold Parker, Worcester, Mass., J. D. Merriwether, territorial engineer, Socorro, N. M., and W. A. McLean, of Ontario highway department, Toronto, were elected vice-presidents; E. L. Powers, of New York City, secretary; W. W. Crosby, of Baltimore, Md., treasurer; A. W. Dean, of Massachusetts high commission, F. D. Lyon, of New York road department, P. L. Hardison, state highway commissioner of Maine, S. D. Foster, of the Pennsylvania highway department, W. J. Roberts, state highway commissioner of Washington, and Clifford Richardson, of New York, directors.

The annual meeting of the Iowa Cement Users' Association elected the following officers: F. P. Wilson, city engineer of Mason City, Iowa, president; H. H. Dean, city engineer of Glenwood, first vice-president; P. H. Armstrong, of Atwood, second vice-president; Keyes C. Gaynor, city engineer of Sioux City, treasurer, and A. O. Anderson, of Ames, secretary.

At the seventeenth annual convention of the Minnesota Surveyors' and Engineers' Society, W. R. Hoag read a paper in which he discussed "Drainage in Northern Minnesota." J. T. Elwell spoke on "Good Roads Legislation," Francis C. Shenehon, dean of the University of Minnesota, read a paper on "The Engineer as a Citizen," and E. K. Coe, engineer of highways for St. Louis county, told of "St. Louis County Highways." The following officers were elected: W. C. Fraser, of St. Paul, president; Thomas F. McGilvray, of Duluth, vice-president; Charles A. Forbes, St. Paul, secretary-treasurer.

Announcement has been made that the annual convention of the National Association of Cement Users will be held in Kansas City, March 11-16, 1912, during the Kansas City Cement Show. The Missouri Highway En-

gineers' Association will meet in Kansas City at the same time.

At a meeting of the Municipal Engineers of the City of New York, held on February 28, H. McL. Harding, consulting engineer, presented a paper entitled "Municipal Problems of Terminal Freight Transference."

The third annual meeting of the American Society of Engineering Contractors was held in New York City on the 9th day of January, 1912. The retiring president, W. R. Harris, spoke on workmen's compensation in Canada, and on the need of further safeguards in concrete work. A general discussion of methods of gathering and compiling cost data, followed by a paper by J. R. Wemlinger on "Methods and Costs of Driving and Pulling Sheet-Piling," completed the evening's program. The result of the election of officers was as follows, President, Maj. C. E. Gillette, of Philadelphia, Pa.; first vice-president, H. J. Cole, of New York, N. Y.; second vice-president, John Marshall, of Regina, Sask., Can.

At the February meeting of the New England Water Works Association, held in Boston on February 14, the following papers were presented: "Some Recent Applications of the Venturi Meter," by Frederick N. Connet, mechanical engineer, Providence, R. I.; "Some Things Domestic Meters do Not Accomplish," by William S. Johnson, sanitary and hydraulic engineer, Boston, Mass.; "Economy of Circular Reinforced Concrete Reservoir Construction," by Alexander Potter, consulting and constructing engineer, New York.

At the annual meeting of the Oregon Society of Engineers, held on February 5, the following officers were elected: D. C. Kenny, president; W. S. Turner, vice-president; J. C. Stevens, secretary; F. A. Naramore, treasurer.

The following were among the papers presented before the meeting of the Iowa Engineering Society, held at Davenport, Iowa, on February 21, 22, 23; "Uniformity in Methods of Staking Out Work and Measuring up Concrete," by Theo. S. DeLay; "Concrete Pavements in Davenport, Iowa," by A. M. Compton; "Concrete Pavements with Bituminous Top," by N. H. Tunnicliff; "Street Lighting," by A. H. Ford; "Electric Motors for Use in Pumping," by J. B. Hill.

The Ohio League of Municipalities, which was organized at Columbus, Ohio, on January 26, elected the following officers: Newton D. Baker, mayor of Cleveland, president; Mayo Fesler, secretary of the Cleveland Municipal Association, secretary; Elliott H. Pendleton, Cincinnati, first vice-president; Mayor F. A. Hartzenstein, Youngstown; Mayor J. J. Miller, Springfield, and David Gottlieb, Tiffin, manufacturer, were elected second, third and fourth vice-presidents, respectively. The executive committee is headed by Mayor Brand Whitlock, of Toledo.

The Virginia Road Builders' Association, organized at Richmond, Va., in November, held a meeting at Norton, Va., on January 25, when a number of papers on highway construction were presented. The officers of the association are: S. H. Fletcher, president, Lebanon; H. M. Darden, vice-president, Suffolk; William F. Cocke, treasurer, Norton; C. B. Scott, secretary, Lynchburg, Va.

The eighth annual convention of the Wood Preservers' Association was held in Chicago, January 16 to 18. Officers elected for next year are: E. A. Sterling, president; A. M. Smith, first vice-president; H. Rollins, second vice-president; Grant B. Shipley, third vice president, and F. J. Angier, Mount Royal Station, Baltimore, Md., secretary and treasurer.

At the annual meeting of the Indiana Engineering Society, held in Indianapolis, January 25, 26 and 27. The officers elected for the coming year were: DeWitt V. Moore, president; H. W. Klausmann, vice-president; D. B. Luten, E. E. Watts and C. A. Tripp, new trustees, and Charles Brossmann, secretary.

The annual meeting of the Illinois Society of Engineers and Surveyors for 1912 was held at the University of Illinois on January 17, 18 and 19. The program was of unusual excellence. The more important engineering topics discussed were Stream Pollution, Sewage Disposal, Accuracy in Surveying, Road and Pavement Problems, and the Bridge Work of the Illinois Highway Commission. Two illustrated lectures of great interest were given, one by Professor I. O. Baker, on the Panama Canal, and one by Mr. H. L. Cooper, chief engineer, on the Keokuk Water Power Plant. An afternoon was spent in inspecting the buildings and discussing the work of the College of Engineering. Officers elected for the coming year are: J. A. Harman, president; L. K. Sherman, vice-president, and E. E. R. Tratman, secretary.

Calendar of Technical Meetings.

National Paving Brick Manufacturers' association.—Annual meeting, Congress Hotel, Annex, Chicago, Ill., March 4-6. Will P. Blair, secretary, Engineers building, Cleveland, O.

American Ceramic Society, Chicago, Ill. March 4-6. Prof. Edw. Orton, Jr., Columbus, O., secretary.

Wisconsin Clay Manufacturers' association, Milwaukee, Wis., March 6-7. S. Weidman, Madison, Wis., secretary.

National Brick Manufacturers' association, Chicago, Ill., March 6-9. T. A. Randall, Indianapolis, Ind., secretary.

Illinois Clay Manufacturers' association, Chicago, March 8-9. A. E. Huckins, secretary, Champaign, Ill.

International Brick and Clay Products exposition, Coliseum, Chicago, Ill., March 7-12. F. L. Hopley, secretary, 815 Chamber of Commerce Bldg., Chicago, Ill.

First Annual Kansas City Cement Show. Convention Hall, March 18-21. J. P. Beck, general manager Cement Products Exposition Co., 72 W. Adams St., Chicago.

American Water Works association. Annual convention, Louisville, Ky., June 3-8. John M. Diven, secretary, 217 River Street, Troy, N. Y.

Technical Schools.

In connection with the graduate course in highway engineering the following illustrated lectures were given during the month of February by non-resident lecturers in highway engineering: February 9—"Contracts and Specifications," Harold Parker, vice-president and manager, The Hassam Paving Company, Worcester. February 16—"Trinidad and Bermudez Asphalts and Their Use in Highway Construction," Clifford Richardson, consulting engineer, New York City. February 19—"The Design of Highways and Systems of Highways," Nelson P. Lewis, chief engineer, Board of Estimates and Apportionment, New York City. February 23—"Inspection of Sheet Asphalt Pavements," A. W. Dow, chemical and consulting engineer, New York City. February 26—"Technical Literature," John M. Goodell, editor-in-chief, *Engineering Record*.

Bulletin No. 52, of the University of Illinois Engineering Experiment Station, states the results by Herbert F. Moore of an investigation of the strength of rolled zinc. Tests of the strength under tensile and shearing stress are noted and a comparison is made with mild steel.

U. S. Civil Service.

The U. S. Civil Service Commission will hold examinations as follows:

March 13, 1912: Aid, Coast and Geodetic Survey; assistant, Philippine service; assistant examiner, Patent office; civil engineer, Philippine service; civil engineer student; computer, Nautical Almanac Office (men only); computer, Naval Observatory (men only); draftsman—copyist topographic, junior engineer, Engineer Department at Large; topographic, departmental; forest assistant, Forest service; forest assistant, Philippine service; industrial teacher (men only), Philippine service; junior engineer (mechanical), Bureau of Mines; junior engineer (mining), Bureau of Mines.

March 20: Laboratory aid and engineer for the forest products laboratory in Madison, Wis.

March 20-21: Assistant engineer in forest products, for duty at Madison, Wis.; engineer in forest products for duty at Madison, Wis.; assistant chemical engineer in forest products, for duty at Madison, Wis.; ballistic engineer, ordnance department at large, Frankford Arsenal, Philadelphia, Pa.

April 10, 1912: Agricultural inspector, Philippine service; assistant observer, weather bureau; cadet engineer, lighthouse service; cadet officer, lighthouse service; civil engineer, departmental service; civil engineer and draftsman; computer, Coast and Geodetic Survey (men only); draftsman—mechanical, Isthmian Canal service; topographic, Isthmian Canal service; engineer, Indian service; junior engineer (civil), engineer department at large; junior engineer (mechanical or electrical), engineer department at large; scientific assistant, department of agriculture; surveyor, Philippine service.

Road Funds to be Provided for Ohio.

The second amendment to the constitution has been adopted by the Ohio constitutional convention, which has been in session since January 9. The amendment permits the state legislature to issue bonds in the sum of $50,000,000 for the support and maintenance in the county of wagon roads. It was adopted by a vote of 72 to 40.

Personal Notes.

Fred R. Charnock has been reappointed city engineer of Medford, Mass.

Samuel J. Paul, Los Angeles, Cal., has been appointed city engineer of Santa Barbara, Cal.

Charles Cottingham, C. E., Danville, Ill., has prepared a steropticon lecture on the Panama canal.

E. P. Roberts, president of the Cleveland engineering sociey, has been appointed city smoke inspector.

H. E. Phelps has been appointed city engineer of Boulder, Colo., succeeding Fred R. Dungan, who has resigned.

W. F. Tye has been elected president of the Canadian Society of Civil Engineers. Henry H. Vaughn is vice-president.

R. F. Stoddard and M. F. McKenna announce the opening of an office for the practice of civil engineering at 83 Fairfield avenue, Bridgeport, Connecticut.

Frederick E. Beck and Alvin L. Gilmore have opened an office at Binghamton, N. Y., to engage in the practice of civil engineering under the firm name of Beck & Gilmore.

Howard A. Parker has been appointed assistant highway engineer by the Wisconsin State Highway Commission. He was ormerly an instructor in civil engineering at the University of Wisconsin.

C. A. Jennings, superintendent of filtration of the Union Stock Yards & Transit Co., Chicago, has been retained by the city of Quincy, Ill., to investigate and report on the water works plant, making recommendations of improvements.

Alexander Potter, consulting engineer, of New York City, has been retained by the city of Springfield, Mo., to design and supervise the construction of sewage disposal plants for the existing north and south sewers. The city voted $100,000 in November to carry out this work.

J. U. Isaacs has been appointed engineer of the division of sewers in the department of the city engineer of Baltimore, Md.; S. R. Alexander has been appointed engineer of bridges; James Paige, engineer of street repairs, and L. J. Houston, Jr., engineer of improved paving.

Edlow W. Harrison, of Jersey City, who has long been identified with the proposed Passaic Valley intercepting sewer as consulting and chief engineer, has tendered to the Sewerage Commission his resignation from the latter office. In Mr. Harrison's place the commission appointed William M. Brown, of Boston.

D. D. Jackson, director of laboratories of the Department of Water Supply, gas and electricity of New York, will have charge of the experiments made with a view to purifying the water supply of Cleveland, O.

Charles E. Collins, of Philadelphia, Pa., has been retained as engineer on the proposed sewerage system and disposal plant at Pottstown, Pa.

MACHINERY AND TRADE

The Standard American Asphalt Pavement.

The use of natural rock asphalts found in the region a few miles south of Ardmore, Oklahoma, has developed a type of asphalt paving, which is unique in many particulars. The different steps in the development of this "Standard American Asphalt Pavement" are very well described in a series of articles by J. S. Downard, president of the Shelby Doward Asphalt Co., Ardmore, Okla., which are briefly abstracted in the following:

The primitive types of bituminous rock pavements are those laid out of a single asphalt rock, which was pulverized, heated, raked over a firm base to a thickness of 2 inches, compressed with a steam roller and opened to traffic. This bituminous rock contained from 7 to 10 per cent. of bitumen (asphalt); the remaining 90 per cent. was sand—these materials being found in nature naturally combined. No bituminous limestone was used.

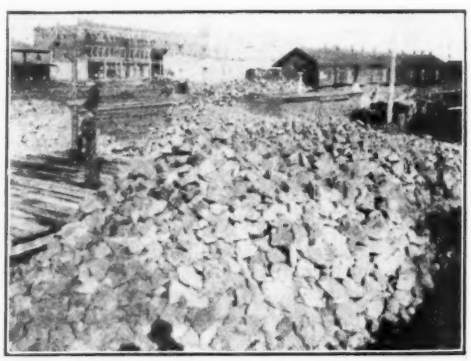
The second step in the industry was to take three different kinds of bituminous rock and combine them, selecting those containing soft bitumen, which would temper others containing harder bitumen, and density was obtained by adding to the sand rocks certain bituminous limestone rocks and certain sand rocks that contained very fine sand. The mixture termed "Standard" carried about 20 per cent. of bituminous lime rock, and the remaining 80 per cent. was composed of a mixture of different kinds of bituminous sand rock. The entire mixture contained from 7 to 10 per cent. of bitumen (asphalt), the balance being limestone and sand.

The third step was to eliminate most of the bituminous sandstone in the paving mixture, retaining the bituminous limestone. The bituminous sandstone was replaced by a mixture of pure graded sand with bitumen (asphalt) added to it, and the bitumen used was the same bitumen that was extracted from the asphaltic sandstone, properly tempered with other asphalts (bitumens), so as to be as near like rubber as possible but to have the durability of natural bitumen. A portion of the bituminous sand rock was retained in the pavement so as to secure the benefit of very fine pure silica, contained only in this material.

Ardmore asphalt is a mixture of sand and natural mineral bitumen, and the Standard specifications call for one-third of the pavement being made out of this material, and to this natural mixture of asphalt, a quantity of sand is added, and to the quantity of pure graded sand, sufficient artificial asphalt and natural asphalt mixed with proper flux to bring up the entire mixture to 100 parts. The result is as follows: Natural sand asphalt—3.3 parts of pure bitumen and 29.7 parts of fine silica sand naturally combined as taken from the mines; 6.7 parts of Oklahoma natural Gilsonite properly fluxed; 60.3 parts of sand obtained locally.

Such part of sand as is deemed necessary to give proper percentage is added.

The bituminous limestone or rock asphalt found in the vicinity of Ardmore consists of a pure limestone formation which is saturated with pure native bitumen. This bitumen is found through the body of the rock wherever it contains voids, and also in seams that exist in the formation. These seams, or rather lines of cleavage, once caused the entire mass of rock to have sufficient minute cracks in the bed to allow the passage of the



ARDMORE ASPHALT READY FOR SHIPMENT.

bitumen through the entire bed of limestone, and under pressure it infiltrated, not only these seams, but the entire body of the rock, eccepting an occasional crystalline limestone mass. The result is a stone of pure carbonate of lime, filled with pure natural bitumen.

The mass breaks into these pieces because of the natural seams, or cleavage. The result, therefore, of a crushing operation is to produce angular and sub-angular pieces of

a solid stone, thoroughly coated with bitumen and thoroughly filled with bitumen so that no moisture can be absorbed, and of such quality that the bitumen on the surface of the stone will be increased in quantity by the application of heat, or new supplies will come to the surface if the supply of coating bitumen is removed from any cause. The accompanying photograph shows the rock asphalt ready for shipment.

The material has been used very extensively in the various forms above described and has for more than ten years proven satisfactory under heavy traffic and in climates as diverse as those of Kansas City and Galveston.

The Smith "Hot" Mixer.

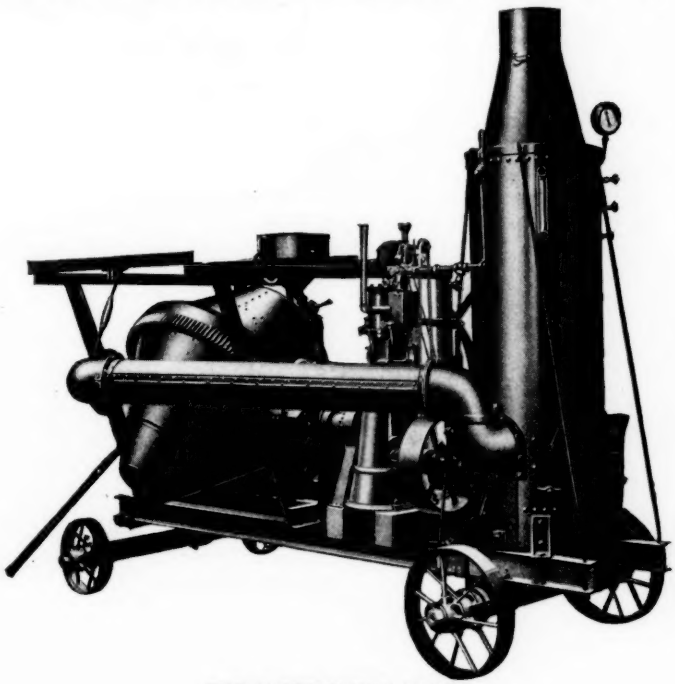
To the road contractor and engineer who has had experience with the heavier types of mixers for bituminous road material, the new Smith "Hot" mixer, manufactured by the T. L. Smith Co., 1330 Majestic Building, Milwaukee, Wis., will at once prove of interest. It is a light but thoroughly efficient machine, having the points of good design and construction, which have characterized the Smith concrete mixers, of which it is really an adaptation. There has been added to the concrete mixer plant, a power charger, tar ladle and tank of special construction, an asbestos-lined heating pipe to conduct the flame from the fire-box to the mixer drum and a steam blower to force the heat through the pipe.

The accompanying photograph shows the discharge end of the machine, with the drum tilted while running; a feature of great value in handling the viscous road material. The operation of the mixer is briefly as follows:

The flame from the fire box is forced into the drum through an asbestos-lined heating pipe, by means of a powerful steam blast. A slide valve at the boiler permits of the accurate control of the heat. By means of a damper in the hood of the boiler, the draft can be diverted through the stack when the heat is shut off from the mixer. The heating attachment is swiveled on the upper, cast-steel elbow, so as to swing away when the drum is tilted.

The power charging attachment is the same as is furnished for concrete mixer service. The lift is vertical and direct, insuring smooth, easy operation. The bituminous ingredient must be introduced into the mixer in liquid form. The ladle is filled, placed upon the sideloader brackets and elevated with the skip. When the skip reaches its highest position, the operator upsets the ladle into the a special tar tank, from which the contents can be fed into the drum as soon as the stone is heated to receive it.

The gases enter the drum at a temperature above 600 degrees Fahrenheit. The materials are "sprayed" by the blades in the drum, al-



THE SMITH "HOT" MIXER.

lowing the heat to reach every particle in the mass. With the ordinary run of stone, as delivered directly from the quarry bins, 2½ minutes are ample to both heat and mix the batch.

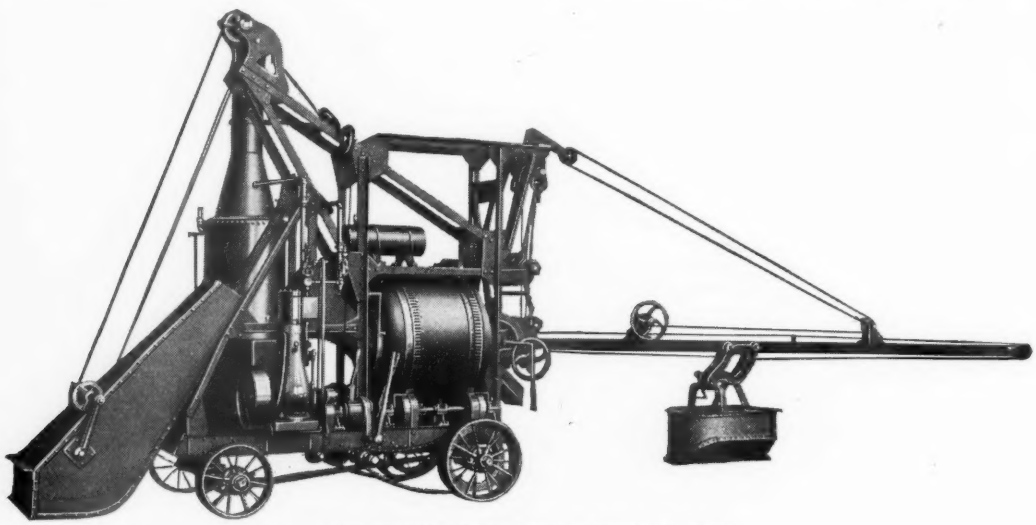
In commenting on a five days test of the mixer, F. O. Brown, president of the Municipal Paving Co., says:

We used various kinds of material.

First, Oklahoma sand rock asphalt in the pulverized state. Second, old Barber material taken off the streets and broken up in small chunks, the size of a person's fist. Third, we used it for asphaltic concrete composed of small trap rock 1-inch in size and under, together with sand and melted asphalt.

For the material first named—pulverized rock asphalt—we heated 11 cu. ft., which is the capacity of our machine, in from 3 to 5 minutes at a temperature of 350 degrees, which is really more than this material requires.

For the second material, it required from 5 to 10 minutes to heat it and reduce it to a condition fit for paving. With this material we added a small percentage of California asphalt.



THE KOEHRING STREET PAVING MIXER.

The last material above mentioned, to-wit: asphaltic concrete, it required from 5 to 7 minutes for a batch of 11 cu. ft. We heated all the material to an average of 350 degrees.

The machine worked entirely to our satisfaction and required from 3 to 7 men to operate it, depending on the class of work we were doing.

I believe that this machine, which is a medium size, made by the Smith people, will lay from 500 to 600 yds. per day of 2-inch think paving material.

For a small capacity of work, we consider this machine a valuable thing to use for asphalt hot mixers.

The Koehring Concrete Mixer Catalog.

The Koehring Machine Co., Milwaukee, Wis., have issued a most complete and very attractive catalog of concrete mixers, hoists and hoisting dumps. This catalog, No. 16, is a most tasteful and complete booklet, illustrated throughout with halftones which are notable for their clearness of detail as regards machine parts and the comprehensive nature of the subject matter.

The fore part of the catalog contains a general description of the mixing feature of the Koehring dump with cutaway views of the interior showing the action of the blocks during the process. Other details of mechanical operations, such as the trunnion rollers supporting the dump; the heavy truck construction; the side loader, etc., are fully dealt with in this portion.

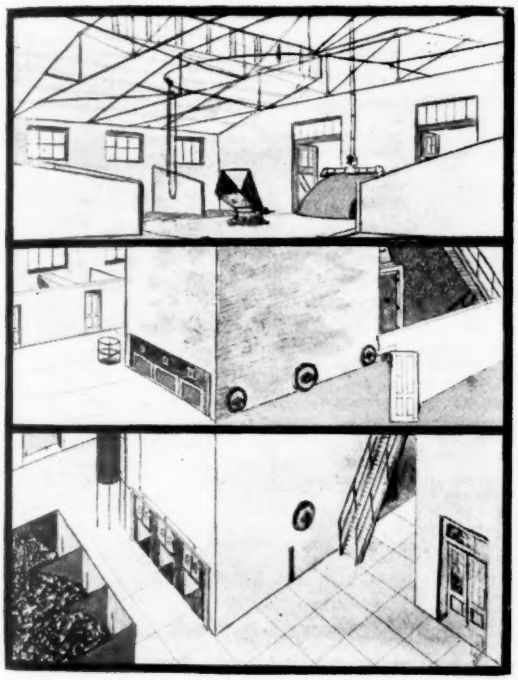
Then follow a number of excellent halftones of the different types of machines; the steam power mixer, the gasoline engine mixer, the motor driver mixer, the mixer with a batch hopper bin, etc., all being shown in full detail. A small mixer shown on page 18 is particularly adapted for concrete work in city parks and other small jobs.

The next portion of the catalog is devoted to concrete hoists and street paving mixers. The street paving mixer, of which a photograph is shown, has been fully described in these pages. The special delivery device is noteworthy and a further improvement consisting of an automatic trip on the delivery bucket has been recently added. This is followed by a number of photographs of actual construction work in which the Koehring machine has played a prominent part. The last twenty-five pages contain specifications and tables, and a number of shop views showing the manufacture of the machine and its various parts.

The catalog apart form its value as an aid to the buyer is of interest and has an educational value by reason of its complete detail and the clear presentation by illustration and description the points set forth.

Harris Combination Incinerator and Power Plant.

J. B. Harris, 210 Stahlman Building, Nashville, Tenn., has entered into connection with the Nashville Bridge company, East Nashville, Tenn., whereby the latter company is to handle all contracts for the Harris combin-



INTERIOR VIEW HARRIS INCINERATOR.

ation incinerator and power plant. The Nashville Bridge company has a plant fully equipped for the manufacture and erection of all buildings and equipment. Bids have been entered for several cities and it is contemplated that five or six plants will be built during the present year.

The Harris invention has been perfected after many exhaustive practical tests and its efficiency both as an incinerator and as a power plant probably excels that of any other similiar device on the market. It is built in units varying from 10 to 250 tons capacity per day, generating power from 100 to 1200 horse power per unit from self-contained water tube steam boilers. It will burn all fumes of city refuse without smoke or odor.

That the plant will pay its operating expense and a good dividend on the investment, is strongly stated by the inventor.

Fireproof Construction Imperative.

Prominent business men, aroused by the discussion concerning House Bill No. 357, just introduced in Congress, say that while it is certainly time that something should be done to put a check upon the appalling fire waste in the United States, yet the investigation of insurance rates is far from offering a solution of the real trouble.

One of the leading Chicago insurance men, Louis Kohtz, Gen. Agt. Aetna Insurance Co., discussing the subject said:

The first effort should be made in securing the united support of all municipalities to establish a standard building code, which will foster genuine fire proof construction, and which will put an end to the building of such flimsy structures as are now a menace to the congested districts of all our cities.

The fire loss in European countries averages only about 30 cts. per capita annually, as against $2.50 per capita annually in this country. There can be no other reason for this difference than that there is something radically wrong with our methods of construction in the United States. Fully 25 per cent. of the new buildings constructed simply replace those destroyed by fire. In this country about one billion dollars worth of new buildings are built annually, and buildings to the value of two hundred and fifty million dollars are burned. To this must be added the cost of fire insurance and the cost of maintaining expensive fire departments, making a total fire waste of over five hundred million dollars. The total fire waste annually amounts to more than the annual production of gold, silver, copper and petroleum in this country.

It is discouraging to note that while our population has increased 74 per cent. in thirty years, our fire loss has increased 134 per cent. in the same period.

Within the last few years, there has been developed a form of construction which can be called absolutely fire-proof, and many of the modern business buildings, of this type, will stand for an indefinite time as monuments to the wisdom of their builders. Such splendid buildings offer the best kind of a fire wall and do much to prevent the spread of fire and serious conflagrations.

Many people have an idea that fire-proof construction is too expensive to be practical for all kinds of buildings, but this is a most erroneous belief, for today it is possible to build, not only business buildings and factories of fire-proof construction at reasonable cost, but also city and suburban residences. In fact, there is no excuse whatever for a building being erected of anything but fire-proof construction at the present time. The slight additional first cost is more than made up by many savings in maintenance and repairs, and in the longer life of the building.

One of the greatest menaces to the public welfare is the misrepresentation regarding the fire-proof character of business buildings. Many so-called fire-proof structures are nothing more than fire traps and a fire well started in them will gut their interiors from cellar to roof. Merely the construction of walls and partitions from fire-proof materials does not make a fire-proof building.

Modern progress in fire-proof construction will be fully demonstrated at the Clay Products Exposition, to be held at the Coliseum, in Chicago, March 7th to 12th. All kinds of fire-resisting and fire-protective ideas in building construction work will be shown in actual structures, which will be erected on

the floor of the Coliseum, including a full size modern fire-proof house.

This fire-proof feature of the Exposition is so important that fire marshals from municipalities throughout the country will be sent to Chicago to attend the show and the movement has the endorsement of the National Fire Marshals' Association.

I heartily commend the plan to show the country at large the merits of fire-proof construction through an industrial exposition, such as that to be held in the Chicago Coliseum, March 7th to 12th.

Reflectors and Illuminating Specialties.

The H. W. Johns-Manville company, already known in the lighting field by reason of their J-M Linolite system of illumination, have acquired the sole selling agency for the entire products of I. P. Frink, who have been engaged in this line of work for fifty consecutive years.

"Frink" reflectors and fixtures need no introduction to the lighting trade aand consumers throughout the country, and this arrangement means that the H. W. Johns-Manville company will be in position to design and sell lighting systems for every known form of artificial illumination.

An engineering department will be maintained along very extensive lines. This department will maintain a corps of engineers throughout the United States and Canada, and will be equipped to place data and recommendations in the hands of all interested in any subject pertaining to illumination.

Rapid Development of Wire-Cut-Lug Paving Blocks.

The latest addition to the brick manufacturing companies which have installed the machinery for making Dunn's wire cut-lug paving blocks, is the Deckman-Duty Brick Co., of Cleveland, O. They will make the blocks at all three of their plants, at Cleveland, Malvern, and Carrollton, O. The list of plants recognizing the necessity of readiness to supply the growing demand for these blocks is growing with increasing rapidity and apparently will end only when all the paving brick plants have entered it.

To aid in taking care of the numerous important problems arising in the development of the business, Mr. Dunn has secured the services of W. T. Blackburn, formerly city engineer of Paris, Ill., and more recently connected with the national and the Illinois paving brick manufacturers' organizations in an advisory capacity, as his consulting engineer. The Dunn Wire-Cut-Lug Brick Co. is located at Conneaut, O.

Good Roads Year Book.

The American Association for Highway Improvement is preparing a Good Roads Year Book of about 350 pages for publication, probably in April, which will be sent to members of the association and will be sold to others at $1. The book will contain much information not heretofore available under such headings as Associations, Appropriations, Books, Brick Roads, Bituminous Macadam, Bridges and Culverts, Chronology, Convict Labor, Concrete Roads, Earth Roads, Gravel Roads, Legislation, Macadam and Telford Roads, Maintenance, Periodicals, Patents, Sand Clay Roads. It will contain lists of bonds issued and contemplated for road purposes, of road contractors, of state expenditures in 1911, of national and state highway officials, of institutions having highway engineering departments, of mileage of roads and improved roads in each state, of manufacturers of road material, vehicles and machinery and of trade names. It will explain fully the work of the U. S. Office of Public Roads and of the association itself.

Application for membership in the association or remittances for the book should be sent to J. E. Pennybacker, Jr., secretary, Colorado Building, Washington, D. C.

Trade Notes.

Hartford City, Ind.—Bids are requested on March 7, at 7 p. m. for removing two old boilers and furnishing and setting two 100-h. p. boilers. Certified checks 2½ per cent. J. G. Trant is city clerk.

Indianapolis, Ind.—Bids are requested on March 11, at 10 a. m., for furnishing 210 carloads of crushed stone, for Marion county highways and 40,000 gallons of Tarvia binder or equal; machines for applications to be loaned by the county. William T. Patton, auditor of Marion county.

Schenectady, N. Y.—An appropriation of $30,000 will be made by the city to install water meters in residences. F. W. Bentley, water superintendent.

Laurinburg, N. C.—Maxcy L. John desires to purchase a transit for city work.

Oxford, O.—Rial T. Parrish desires to purchase a dumpy level and Philadelphia rod.

Pittsburgh, Pa.—The rapidly increasing demand in Pittsburgh and vicinity for the asbestos magnesia and other products of the H. W. Johns-Manville Co., has necessitated a move from their present location in Liberty Avenue, about Ninth Street, to larger quarters. After January 24, 1912, the Pittsburgh branch of the H. W. Johns-Manville Co. will occupy the entire eight-story stone, reinforced concrete and steel building at the northeast corner of Wood Street and First Avenue, which has been leased by them for a term of years.

San Antonio, Tex.—The contract between the city of San Antonio Texas and the San Antonio Water Supply Co., owned by Belgian capitalists, expires in June of this year. The city of San Antonio has engaged the services of Alexander Potter, consulting engineer, of New York, to make an appraisement of the existing water works plant, and prepare plans for the extension and rehabilitation of the existing system to make the system efficient from a fire-fighting standpoint as well as adequate for domestic use; also to prepare a new contract with the water company, suggesting a schedule of rates at which, in his judgment, the company should be willing to supply water to the city for fire purposes and domestic consumption. The work also includes an audit of the books of the water company on behalf of the city. Mr. Potter has agreed to present a complete report, with plans, by the first day of June, 1912.

San Juan, Porto Rico.—Special. The Commissioners of the Interior desire to obtain for file and reference for the different divisions of the department, public works; buildings; irrigation, etc.; catalogs and price lists of machinery, tools, materials, supplies, etc. E. S. Wheeler, assistant commissioner.

IMPROVEMENT AND CONTRACTING NEWS

RMP

ROADS AND PAVEMENTS.

BIDS REQUESTED.

Daytona, Fla.—March 5. Road construction as follows: 100,000 cu. yds. embankment and 90,000 cu. yds. hard surface rock. E. C. & D. M. Rogers, 447 North Beach St., Daytona, Fla., engineers.

Jacksonville, Fla.—March 15, 10 a. m. Paving the Hogan road for a distance of 4 miles. Gail L. Barnard, county engineer.

Brookville, Ind.—March 5, 1 p. m. Constructing highway in Whitewater township. Chas. E. Reifel, auditor.

Crawfordsville, Ind.—March 5, 10 a. m. Constructing highways in Union and Brown townships. Bennett B. Engle, auditor.

Crown Point, Ind.—March 6, 12 m. Constructing 4 gravel roads in North township. E. A. Johnson, auditor.

Decatur, Ind.—March 4, 10 a. m. Constructing a macadamized road in Monroe township. H. S. Michaud, auditor.

English, Ind.—March 4, 2 p. m. Constructing a pike road in Ohio township. J Evans Jones, auditor.

Hartford City, Ind.—March 5, 2 p. m. Constructing macadam road in Harrison township. James Cronin, Jr., auditor.

Huntington, Ind.—March 7, 10 a. m. Constructing 4 highways in Warren township. Harold Guthrie, auditor.

Indianapolis, Ind.—March 1, 10 a. m. Grading and paving with wooden block, asphalt, bituminous concrete, bitulithic, or brick, Ruckle st., from Thirtieth to Thirty-third st. C. A. Schrader, president board of public works.

Indianapolis, Ind.—March 1, 10 a. m. Grading and paving Wallace st., from Washington to New York st., with wooden block, asphalt, bituminous concrete or brick. C. A. Schrader, president board of public works.

Indianapolis, Ind.—March 1, 10 a. m. Grading and paving with wooden block, asphalt, bituminous concrete or brick, Emmett st., from Alabama to Hudson st. Board of public Works.

Lawrence, Ind.—March 5, 10 a. m. Constructing highway in Jackson township. Williams S. Fagaly, auditor.

Marion, Ind.—Feb. 29, 2 p. m. Constructing highway on line between Waltz and Liberty township and Richland. E. H. Kimball, auditor Grant county.

Monticello, Ind.—March 5, 12 m. Constructing a stone road in Jackson county. A. B. Fisher. auditor.

Newport, Ind.—March 11, 10 a. m. Constructing a macadamized road in Vermillion and Engene townships. H. T. Payne, auditor.

Princeton, Ind.—March 6, 10 a. m. Constructing gravel road in Johnson township. William C. Roberts, auditor.

Shelbyville, Ind.—March 7, 10 a. m. Constructing 2 highways in Noblesville township. Frank W. Fagel, auditor.

Shoals, Ind.—March 4, 10 a. m. Constructing macadam road in Perry and Halbert townships. John Morris, auditor.

Valparaiso, Ind.—March 5, 10 a. m. Constructing 3 roads in Porter county. B. A. Blakly, auditor.

Vevay, Ind.—March 4, 1 p. m. Constructing highway in Pleasant township. John Culbertson, auditor.

Vincennes, Ind.—March 5, 10 a. m. Constructing 2 gravel roads in Miami township, macadamized road in Eel township and gravel road in Clinton township. J. E. Wallace, auditor.

Williamsport, Ind.—March 4, 1 p. m. Constructing gravel road in Pike township. David H. Moffett, auditor.

Williamsport, Ind.—March 4, 1 p. m. Constructing a gravel road in line between Pike and Steuben townships. David H. Moffett, auditor.

Winamac, Ind.—March 5, 12 m. Constructing a number of public highways. W. C. Munchenburg, auditor.

Winchester, Ind.—March 7, 10 a. m. Improving 12 public highways. Henry F. Wood, auditor.

Petoskey, Mich.—March 1. Constructing county road. G. W. Dickinson, clerk of Emmet county.

Helena, Mont.—March 4. Paving construction as follows: 19,000 cu. yds. grading, 94,000 sq. ft. concrete walk, 2,500 lineal feet concrete cross-walks, 16,200 lineal feet concrete curb, 565 sq. yds. granite pavement. Chas. W. Heimick, city engineer.

Yonkers, N. Y.—March 4. Grading and improving 241st. James V. MaHony, secretary, board of contract and supplies.

Caldwell, Ohio.—March 15. Improving the Combs road. Harry A. Smith, clerk.

Delaware, Ohio.—March 9, 1 p. m. Road construction as follows: County Line road, .49 mile; the Oxford and Norton roads, .36 mile; the Felkner road, 1.02 miles. Macadam construction. Certified check $300 on each bid. W. H. Whittier, county surveyor.

Richwood, O.—March 9, 2 p. m. Paving portions of Ottawa st. O. Boggs, village clerk.

Steubenville, O.—March 5, 12 m. Constructing a retaining wall. Certified check $100. Sherman Floyd, clerk board of Jefferson county commissioners.

Salina, Pa.—March 16, 6 p. m. Constructing about 500 feet of brick road. Certified check $200. W. H. Wilson, Saltsburg, Pa., engineer.

Racine, Wis.—March 9, 10 a. m. Paving McKenzie ave., including 10,900 sq. yds. of pavement. E. H. Connolly, city engineer.

CONTRACTS AWARDED.

Hamilton, Ala.—Constructing road from Hamilton to Guym, to A. F. Beardon, Birmingham, Ala., $17,350.

Stockton, Cal.—Improving nine miles of Roberts Island road with oil macadam and for graveling and oiling a road between Tracy and Vernalis, a distance of about 14 miles, to Cy. Moering, Jr., at $50,301 and $51,132 respectively; improving Mariposa road, to F. C. McIntyre, for $42,957.

Barnesville, Ga.—Paving a number of streets, to J. B. McCrary, Atlanta, Ga., $30,000.

Lewiston, Ill.—Constructing 20 blocks of brick paving to the Fuller-Coult Construction Co., Chemical Bldg., St. Louis, Mo.

Bloomington, Ind.—Constructing macadam road in Perry township and Bean Blossom township, to Wm. Smith, Bloomington, Indiana, $11,738.

Indianapolis, Ind.—Constructing gravel roads in Warren county, to W. O. Thomas, Pine Village, Ind., $6,760, and to Greenup & Co., Ambia, Ind., $10,805.20.

Lebanon, Ind.—Paving North Meridian st., to Geo. G. Miller, $20,035.

Michigan City, Ind.—Constructing 3 pavements, to the Western Construction Co., Lafayette, Ind.

Portland, Ind.—Constructing stone road in Richmond township, to Nicolson & Pierce, Alexandria, Ind., $15,260.

Rushville, Ind.—The following road contracts have been awarded: the John Jordan road, to O'Connor Bros., $9,400; the William Leisure road, to J. A. Hardin & Co., $15,659; the J. M. Amous road, to J. B. Reasoner, $15,934; the Issac Webb road to Thurston & Steel, $4,490; the Earl Beaver road, to J. W. Stevens, $8,350; the Robert Nixon road to Nicholson & Pearce, $16,667; the W. A. Mull road to Thurston & Steel, $14,440; the E. B. Louden road to Nicholson & Pierce, $39,098.

Corning, Ia.—Constructing 13,869 sq. yds. brick paving, 457 sq. yds. concrete paving, and 11,463 lineal feet combined curb and gutter to Dunnegan & Hamilton, Shenandoah, Ia. T. F. Delay, Creston, Ia., engineer.

Eldora, Ia.—Constructing 22 blocks of concrete pavement, to J. S. McLaughlin & Son, of Red Oak, Ia.

Louisville, Ky.—The following paving contracts have been awarded: Alta, Sherwood and Bonnycastle aves., between Bardstown road and Cherokee Park, to the Jefferson County Construction Co., $67,341; Thirty-fourth st., from Chestnut st. to first alley south of Magnolia ave., to the Louisville Asphalt Paving Co., $6,426; Barbee st., from First to Brook st., and Rosewood ave., from Baxter ave., 466 ft. south, and Bolling ave., to the S. S. Saxton Co., at $8,779 and $11,116 respectively.

Tompkinsville, Ky.—Paving, with vitrified brick, four miles of pike from Tompkinsville toward the Cumberland river, to W. C. Overly & Co., Joplin, Mo., $114,000.

Boston, Mass.—The following paving contracts have been awarded: preparing asphalt pavement, to the Warren Bros. Co., Boston, Mass., $32,370; furnishing curbing, to F. & R. J. Lombard, Boston, Mass.

Kansas City, Mo.—Constructing pavements and grading subways, to C. F. Betz, Sioux Sity, Ia., $25,000.

Syracuse, N. Y.—The following paving contracts have been awarded: Elk st., with sheet asphalt and vitrified brick, to Fred J. Baker, $11,570; Granger st., with asphalt, to the Warner-Quinlan Co., $1,460; constructing sidewalks on Onondaga ave., to Antonio Mando, $949.

Ravenna, O.—Constructing brick pavement in Section So. 1 and 2 of the Ravenna-Randolph road, to Morgan Bros., of Ravenna, at $59,500 and $37,586 respectively.

Portland, Ore.—The following paving contracts have been owarded: paving Alameda park tract with gravel bitulithic, Warren Construction Co., $147,000; grading and laying concrete curbs and sidewalks as follows: E. 11th st., to Oregon Independent Paving Co., $2,089; Webster st., to Beehill Bros., $725; Sumner st., to Carter Bros., $6,139.

Johnson City, Tenn.—Paving in district number 9, to the Cleveland Trinidad Paving Co., $87,000.

Houston, Tex.—Paving Houston Heights blvd. with vitrified brick, to E. J. Overly & Co., Joplin, Mo., $114,845.

Houston, Tex.—Paving the Houston Pike blvd., to the Creosoted Wood Block Paving Co., New Orleans, La., $22,349.

Paris, Tex.—Paving North Main st., to Western Paving Co., Oklahoma City, Okla., $30,760.

North Yakima, Wash.—Paving 9 blocks with bitulithic, to the Pacific Paving Co., $43,737.

Seattle, Wash.—Grading and curbing 22nd ave. N., to L. H. Goerig, Seattle, for $18,766.

Milwaukee, Wisc.—Paving Grand ave., extension west of the Grand avenue viaduct, to R. W. Forrestal, Milwaukee, Wisc., $22,400.

CONTEMPLATED WORK.

Bentonville, Ark.—W. G. Patterson, Ridge, Ark., has prepared plans for the construction of 25 miles of gravel macadam road, to cost about $40,000.

Ft. Smith, Ark.—Bids will soon be asked for paving Garrison ave. M. H. Reed, engineer.

Oakland, Cal.—City engineer has been directed to prepare plans for paving 14th st., from Jackson to Oak, and for improving Lake Shore ave., Fifth ave., and E. Twenty-second st.

Suffield, Conn.—A $20,000 bond issue for road construction has been voted. E. Halladay, town clerk.

Washington, D. C.—An American consul reports that a municipality in his district is contemplating street improvement to cost $33,000. Address Bureau of Manufacturers, Number 8027.

Live Oak, Fla.—The paving of three streets with brick to cost about $22,000 is contemplated.

Atlanta, Ga.—The street and sewer committee of the city council has outlined paving work and sewer construction for the coming season to cost about $1,000,000.

Barnesville, Ga.—Grading and paving a number of streets, to J. M. McCrary Company, Atlanta, Ga.

Aurora, Ill.—The construction of about 5 miles of brick paving is contemplated.

Chicago, Ill.—The extension, boulevarding, parking and illuminating of Sheridan road from Devon ave., thirty miles north, is contemplated. Lincoln Park Comrs.

East St. Louis, Ill.—Edward F. Harper, city engineer, is preparing estimates for the paving of State St., to cost about $800,000.

Freeport, Ill.—The paving of Float, Benton and Delaware sts., with brick, to cost about $25,000, is contemplated.

Pana, Ill.—The paving of 8 streets is contemplated and bids will be asked about March 5.

Rochelle, Ill.—The construction of about 30,000 sq. yds. of brick pavement is contemplated. Aetna Engineering Bureau, 17 La Salle, St., Chicago,, are engineers.

Rock Island, Ill.—The paving of 6 blocks on Second ave., with asphalt is contemplated. Wallace Treichler, city engineer.

Sterling, Ill.—Street paving, to cost about $40,000, is contemplated. Board of local improvements.

Waukegan, Ill.—The construction of a new pavement in County St., at an estimated cost of $10,000 is contemplated.

Indianapolis, Ind.—The paving of Park ave., from Fall Creek blvd. to 34th st., Thirtieth st., from Central to College ave., and Thirty-fourth st., from Illinois to Central, is contemplated. Board of public works.

Richmond, Ind.—The paving of 8 blocks on South Eighth st., with brick is contemplated.

Cedar Falls, Ia.—City council has passed a resolution authorizing nearly five miles of paving in the residence districts.

Clinton, Ia.—R. C. Hart, city engineer has prepared plans and estimates for the

paving of 5th ave., figures being given, on wood block, concrete, vitrified brick, and asphalt.

Iowa Falls, Ia.—The paving of 16 blocks of street with concrete is contemplated.

Sheldon, Ia.—The city engineer has been instructed to prepare plans for paving 22 blocks of streets.

Sioux City, Ia.—The paving of Jackson st. is contemplated. A. A. Smith, mayor.

Baltimore, Md.—The paving of street sections aggregating about eight miles is contemplated. Estimated cost, $40,000. Paving commission.

Salisbury, Md.—A bond issue of $50,000 for street and sewer improvements will be voted.

Alma, Mich.—A $30,000 bond issue for the paving of Main st., has been voted.

Bessemer, Mich.—A bond election will be held in April for the purpose of voting $150,000 for road improvement, in which event the Marenisto-Gogeit road will be constructed for 39 miles. Contracts will be let in the early spring for 18,000 yards of dirt excavation and grading on the above road. H. A. Harper, engineer.

Grand Rapids, Mich.—E. H. Christ, cons. engineer is preparing plans for paving Lowells st. with brick. A $25,000 bond issue has been voted.

Pigeon, Mich.—A bond issue of $25,000 has been voted for stone road construction.

St. Paul, Minn.—Bids will soon be advertised for repaving Fourth st., from St. Peter st. to Seven Corners, at an estimated cost of $15,000.

Joplin, Mo.—Asphalt paving to cost about $25,000 is contemplated.

Greenwood, Miss.—The construction of a mile of paving esimated by the council to cost about $6,000 is contemplated.

Gowanda, N. Y.—Laying 2½ miles of brick pavement, is contemplated. President board of trustees.

Schenectady, N. Y.—The construction of a municipal paving plant to cost about $15,000 is contemplated.

Seneca, Falls, N. Y.—Paving construction to cost about $20,000 is contemplated.

Warsaw, N. Y.—Brick pavement construction to the amount of $35,000 is contemplated.

Hendersonville, N. C.—A $24,000 bond issue for the paving of Main St. and 6th ave., with asphalt has been voted.

Statesville, S. C.—A $400,000 bond issue for highway construction, including a number of steel highway bridges, has been voted. W. S. Fallis, county engineer.

Canton, O.—The paving of Allen st. with vitrified blocks is contemplated.

Cleveland, O.—Plans have been prepared for paving the following streets: E. 99th st., 2 sections; Adams ave., and Ostend ave. R. E. Collins, city clerk.

Genoa, O.—Geo. Champe, of Toledo, O., is preparing plans for the paving of Main st.

Tulsa, Okla.—P. C. Hughes, city engineer, has prepared plans for the construction of 5 blocks of brick pavement with asphalt filler to cost about $23,000.

Bonham, Tex.—According to the plans of city engineer Thurmond, $60,000 will be spent this year for concrete sidewalks.

Fort Worth, Tex.—The paving of West 5th st. has been ordered by the city commission.

Port Arthur, Tex.—A bond issue of $12,000 for sidewalk improvements has been voted by property owners of Stillwell Heights.

Victoria, Tex.—A $200,000 bond issue for roads construction has been voted.

North Yakima, Wash.—The paving of Yakima ave., Turner st., Miles ave., W. Chestnut st., and 7th ave., South, is contemplated.

Neenah, Wisc.—The paving of the Boulevard in East Wisconsin ave., to cost about $60,000 is contemplated.

SEWERS.

BIDS REQUESTED.

McLeansboro, Ill.—March 9, 1 p. m. Drainage construction as follows: Number 1, 2 foot base, 1 to 1 slope and 4 feet deep, 13,600 cu. yds.; number 2, six-foot base, 1 to 1 slope and 5 feet deep, 31,600 cu. yds. Certified check $100 on Number 1, and $200 on Number 2. L. E. Lambert, county clerk.

Lansing, Mich.—March 4, 4 p. m. Constructing sewer in Herbert st., Isabel and other streets. Certified check $2,000. Peter F. Gray, city clerk.

Rochester, N. Y.—March 13, 11 a. m. Sewer construction as follows: 9,300 feet of 66-inch pipe for discharge of effluent from disposal works into Lake Ontario, 2,300 feet in open trench and 7,000 submerged and in 50 feet of water at the timber crib. Certified check $20,000. Bond $100,000. F. X. Piper, secretary board of contracts and supplies.

Yonkers, N. Y.—March 4. Constructing sewer in 242nd st. James V. MaHony, secretary board of contract and supplies.

Carnegie, Pa.—March 7, 7:30 p. m. Constructing 15-inch storm sewer on Jane St. Certified check 5 per cent. John B. Hiles, chairman street committee.

St. Elmo, Tenn.—March 1, 7 p. m. Sewer construction as follows: 14 mile pipe sewer 18 to 24 inches; one sewage disposal plant; bridge across Chattanooga st., 400 lineal feet of tunnel. H. B. Wilson, mayor. Cushman-Fairleigh Engineering Co., 724 J. E. Bldg., Chattanooga, Tenn., engineers.

CONTRACTS AWARDED.

Pasadena, Cal.—Constructing sewers on El Molino ave., to R. S. Mikeevich, 2824 7th ave., Los Angeles, Cal.

San Francisco, Cal.—Construction section C of the Engleside sewer to the Contra Costa Construction Co., $60,500.

Atlanta, Ga.—The following sewer contracts have been awarded: furnishing iron castings, to the Southern Iron and Equipment Co., Atlanta, Ga., $75,000; cement, to R. O. Campbell Coal Co., Atlanta, Ga., $10,000; sewer pipe, to the Bibb Sewer Pipe Co., of Macon, Ga., $50,000; constructing sewer complete, to the McCrary Excavating Co., Atlanta, Ga., $100,000.

Columbus, Ind.—Constructing the Maple Grove Sewer, to Lea & Everroad, Columbus, Ind., $32,225.

Atchison, Kas.—Constructing West Atchison sewer, to Williams & Sample, Kansas City, Mo., $22,561.

Lawrence, Kas.—The following sewer contracts have been awarded: to Graeber Bros., 3 contracts at $5,377, and $2,129; to W. J. Gilmore, $3,192; W. C. Keller, Kansas City, Kas., $2,748.

Seneca, Kas.—Constructing complete sewerage system including 12 miles of pipe line and a disposal plant, to Wm. F. Plummer Co., Springfield, Mo., $62,000.

Baltimore, Md.—Constructing High Level Interceptor, to McDermott Construction Co., Washington, D. C., $183,156.

Minneapolis, Minn.—The following contracts for sewer material have been awarded: 1,000,000 sewer brick, to the Wisconsin Red Pressed Brick Co., at $9.35; lumber, to the Northland Pine Co., $7,299; 20,000 barrels of Portland cement, to the Northwestern State cement company, at 86½ cents; 300,000 paving brick, to the Minnesota Paving Brick Company, at $16.50;

200 tons of sewer castings, to the American Brake Shoe & Foundry Company, $31.75.

St. Paul, Minn.—Building the St. Anthony ave. sewer to Fraser & Danforth, 411 Hackney Bldg., St. Paul, $14,500.

Canton, O.—Constructing sanitary sewer in Harrison ave., to P. Christiansen, $2,145; constructing sewer in Cedar st., to F. A. Downs Construction Co., $62,590.

New Philadelphia, Ohio.—The following sewer contracts have been awarded: to the Van Meter Construction Co., Steubenville, Ohio, sanitary sewer, $52,410; to Henderson Bros., Coshocton, Ohio, storm sewer, $27,-363.

Roseburg, Ore.—Constructing sewerage system, to J. N. Calvert, Grants Pass, Ore., $8,962.

Harrisburg, Pa.—Constructing sewers, to the Central Construction & Supply Co., Harrisburg, Pa., and to Stecker Bros., Harrisburg, Pa.

Seattle, Wash.—Constructing sewers in North 78th st., to Johnson & Co., Seattle, Wash., $13,031.

CONTEMPLATED WORK.

De Queen, Ark.—Dickinson & Watkins, Little Rock, Ark., have been retained to prepare plans and estimates for a sewerage system to cost about $35,000.

Van Buren, Ark.—W. B. Bell, has prepared plans and estimates for the construction of sewers in sewer district Number 3 which covers practically the entire city.

Fullerton, Cal.—Cloan and Robeson, San Francisco, Cal., are preparing plans for the construction of a municipal water works system and a complete sewerage system.

Oakland, Cal.—An $82,000 bond issue for main outlet sewers in sanitary districts 1, 2, 3, and 4 has been issued.

Ordway, Colo.—The George H. Fachman Co., Denver, Colo., has been retained to prepare plans and estimates for a complete sewer system.

Hartford, Conn.—Plans have been submitted by city engineer Clark for a trunk sewer in Maple ave., to cost about $180,000.

Washington, D. C.—An American consul reports that a municipality in his district is planning sewerage improvements to cost $712,000; sewerage connections to cost $100,-000; and storm water drainage to cost $200,-000. Address Bureau of Manufacturers, number 8027.

Atlanta, Ga.—The street and sewer committee of the city council has outlined paving work and sewer construction for the coming season to cost about $1,000,000.

Morrison, Ill.—Civil engineer Hills, Fulton, Ill., has been retained to prepare plans for a sewerage system.

Quincy, Ill.—W. P. Bushnell, city engineer is preparing plans for the South Quincy sewer system.

Gary, Ind.—H. P. Melton, has prepared plans for a sewerage system to cost about $225,000.

Des Moines, Ia.—Bids on sewer work estimated at $140,000 have been rejected. New bids will be requested. John Budd, city engineer.

Des Moines, Ia.—Plans for the construction of a sewer in the 7th ward to cost $125,000 have been approved.

Sioux City, Ia.—The city clerk will soon advertise for bids for constructing a storm water sewer in Upper Jackson st.

Tipton, Ind.—The construction of a sanitary sewer system is contemplated.

Jeffersonville, Ky.—The Jeffersonville Power, Light and Water Company has made application for a franchise for the construction of a sanitary sewerage system to be leased to the city for $12,900 per year.

Salisbury, Md.—A bond issue of $50,000 for sewer and paving improvements will be voted.

Lynn, Mass.—The construction of a sewage purification plant has been recommended by the Lynn Harbour Board, Wm. C. Dorman, president.

Minneapolis, Minn.—The council sewer committee has recommended the sale of $100,000 bonds for sewerage works.

Annabelle, Mo.—Construction of sewers in district Number 200 is contemplated.

Fayette, Mo.—Rollins and Westover, Kansis City, Mo., are preparing plans for a sewer system to cost $29,675.

Springfield, Mo.—Plans are being prepared by Alexander Potter, and bids will soon be asked for a new sewage disposal plant. J. H. Langston, city clerk.

Lewiston, Mont.—Plans for the construction of a sewerage system to cost about $50,-000, have been prepared.

Libby, Mont.—Building a main sewer, to cost about $15,000, is contemplated.

Longport, N. J.—The installation of a sewage disposal plant is contemplated.

Trenton, N. J.—The construction of a sewage disposal plant to dispose of 100,000,000 gallons of sewage daily is contemplated. Estimated cost $45,000. City clerk Salter.

Albion, N. Y.—Chas. Engersoll has prepared plans for a complete sewerage system and disposal plant to cost about $150,-000.

Brooklyn, N. Y.—An expenditure of $5,-000,000 for the erection of sewage disposal plants to take care of the surplus sewage now flowing into Jamaica Bay, is being urged.

Oswego, N. Y.—Olin H. Landreth has been retained to prepare plans for a complete sewerage system.

Schenectady, N. Y.—Plans are being made for a new sewage disposal system. W. Thomas Wooley, city engineer.

Syracuse, N. Y.—Constructing sewers in Spencer and W. Division sts., contemplated.

Winston-Salem, N. C.—Plans for extension of sewerage system in East Winston have been completed. J. N. Ambler, C. E.

Alliance, O.—The construction of sanitary sewers in Vine and Perry sts., and Rockhill ave., is contemplated.

Hamilton, O.—Funds amounting to $14,-000 are available for the construction of sewers and sidewalks.

New Philadelphia, O.—G. E. Arnold has prepared plans for a sewerage system to cost about $100,000.

Springfield, O.—The construction of the Maiden Lane sewerage system to cost about $40,000 is contemplated.

Youngstown, O.—The construction of a sewer in Ohio st. is contemplated.

Portland, Ore.—The city engineer has prepared plans for the construction of 2 trunk sewer systems to be known as the East Stark St., sewer system number one and two.

Brackenridge, Pa.—Plans are being prepared for the improvement and extension of the sewerage system.

Ellwood City, Pa.—Plans are being prepared for constructing the Fifth st. sewer. Alex Main, boro engineer.

Harrisburg, Pa.—Samuel G. Dixon, state commissioner of health has approved of plans of the boroughs of Rankin and North Braddock to construct sewers and drains into the Monongahela river.

Meadville, Pa.—The construction of a new sewage disposal plant is being urged.

Nazareth, Pa.—A new sewer system, to cost $20,000 is contemplated.

Tarentum, Pa.—Finance Com. of city council has been authorized to borrow $14,-000 for extension of the sewer system.

Uniontown, Pa.—Samuel E. Dixon, state commissioner of health has approved plans for the construction of a disposal plant by the towns of Uniontown and S. Bethlehem, Pa.

Sioux Falls, S. D.—A $200,000 bond issue

has been voted for installing an adequate sewerage system.

Austin, Tex.—Plans are being prepared by city engineer Iredell for a sewer on Comal st.

Calvert, Tex.—The Fountain-Shaw Co., Dallas, Tex., is preparing plans for the construction of a complete sewerage system.

Midland, Tex.—A company is being organized and will be incorporated for $50,000 for the purpose of constructing a sewerage system.

Terrell, Tex.—The city is contemplating the purchase of a sewerage system which is operated by a private corporation.

Rocky Mount, Va.—Installation of a sewerage and water works system is contemplated. J. L. Ludlow, of Winston-Salem, will make surveys.

Bellingham, Wash.—W. H. North, city engineer, has prepared estimates for a trunk sewer to cost about $12,000.

Cashmere, Wash.—Sewer construction to cost $17,500 is contemplated.

Barbourville, W. Va.—An $11,500 bond issue for sewer improvements has been voted.

WATER WORKS.

BIDS REQUESTED.

Savannah, Ill.—March 5, 8 p. m.—Furnishing and installing water works equipment including boilers, pumps, cast iron pipe, and etc. H. T. McKinney, clerk. A. T. Maltby, 803 Great Northern Bldg., Chicago.

Henderson, Ky.—March 2. Furnishing plans for a complete filtration plant. W. I. Thompson, mayor.

Baltimore, Md.—March 6, 11 a. m. Constructing masonry dam including the following: coffer dam, 35,000 cu. yds. rock and earth excavation, 4,600 cu. yds. excavation in cut-off, 38,000 cu. yds. concrete and rubble concrete, 21,000 lbs. steel reinforcing, 70,000 pounds steel bridge. Certified check, $20,000. Ezra B. Whitman, water engineer.

Cincinnati, O.—March 4, 12 m. Furnishing water works pumping equipment and 125,000 gal. elevated steel water tower for the village of Madisonville, O. Director of public service, city hall, Cincinnati.

Cincinnati, O.—March 4, 12 m. Furnishing water works pumping equipment for plant at Carthage, O. Certified check $500. Director of public service, city hall, Cincinnati, O.

Durand, Wisc.—March 1. Constructing 180,000 gal. concrete reservoir and 16,000 feet of mains for water works extensions. H. G. Gilman, Mondovi, Wisc., engineer.

Burnaby, B. C., Can.—March 11, 5 p. m. Supplying 35 miles of steel pipe from 3 to 10 inches in diameter. W. Griffith, clerk municipal council. Cleveland & Cameron, 506 Winch Bldg., Vancouver, B. C., engineer.

CONTRACTS AWARDED.

Macon, Ga.—Furnishing 2,500 tons of cast iron pipe, to the U. S. Cast Iron Pipe & Foundry Co., of Chattanooga, Tenn.

Anna, Ill.—Constructing a water distributing system, including 6,888 ft. of 8-in. cast iron pipe; 8,665 ft. of 6-in. cast iron pipe; 7,995 ft. of 4-in. c. i. pipe; 43 hydrants, 25 valves and valve boxes, to T. C. Brooks & Son, of Jackson, Mich.

New Athens, Ill.—Constructing a water works system, to the Hall Construction Co., East St. Louis, Ill., $17,039.

Henderson, Ky.—Constructing 10 wells for water works system, to E. S. Coudna, Madisonville, Ky.

Boston, Mass.—The following water works system and an electric light plant, ishing cast iron pipe to the United States Steel Cast Iron Pipe & Foundry Co., 2,900 tons at $20.95, and 25 tons of specials at $20.95; furnishing 750,000 pounds number one iron castings, and 250,000 pounds number 2 iron castings to the Roxbury Iron & Brass Foundry Co., Roxbury, Mass.

St. Charles, Mo.—Improving water works system, to Bull & Weberly, St. Charles, Mo., $20,144; constructing pipe line, to John Schulz, St. Charles, Mo., $8,803.

Charlotte, N. C.—Constructing a 65,000,000 gallon reservoir, to Johnson, Porter and Peck, Charlotte, N. C., $31,359; Gilbert C. White, Charlotte, N. C., engineer.

Hammon, Okla.—Constructing a water works system and an electric light plant, to Hunter & Hunter, of Oklahoma City, Okla., $16,943.

Porum, Okla.—Kennedy and Fleming, Oklahoma City, Okla., have been awarded the contract for the construction of a water works and electric light plant to cost $33,000.

Jacksonville, Ore.—Constructing water works system complete, to Jacobson-Bady Co., Portland, Ore., $27,000.

Chamberlain, S. D.—Installing water works system complete, to the Black Hawk Construction Co., Waterloo, Ia., $15,945.

Johnson City, Tenn.—The following water works contracts have been awarded: furnishing pipe, to the U. S. Cast Iron Company, Chattanooga, Tenn., $95,471; laying mains, to F. R. Stone & Co., Oklahoma City, Okla., $42,215; constructing reservoirs, to Oliver & Hill, of Marysville, Tenn., $16,177; constructing intake, to Flynn & Co., Chattanooga, Tenn., $1,000; constructing manholes, to the Central Construction Co., Lexington, Tenn., $235.

Norfolk, Va.—Constructing about 10 miles of pipe line including wooden and iron pipe from 16 inches to 24 inches in size, to Perry W. Ruth & Co., $110,000.

CONTEMPLATED WORK.

Fayetteville, Ala.—Plans are being prepared for the construction of a water works and sewerage system.

Nogales, Ariz.—The city has purchased and is contemplating extensions to the water works system. Purchase price, $60,000.

Argenta, Ark.—Extensive improvements to the water works system are contemplated.

Berryville, Ark.—The Will F. Plummer Co., of Springfield, Mo., has been retained to prepare plans and estimates for the construction of a complete water works system.

Fullerton, Cal.—Sloan & Robeson, San Francisco, Cal., are preparing plans for the construction of a municipal water works system and a complete sewerage system.

Wilmington, Del.—All bids received for the installation of the new turbine wheels and triplex pumps were rejected by the water commissioners and the chief engineer was instructed to prepare new plans and specifications.

Preston, Idaho.—C. H. Reed, Spokane, Wash., is preparing plans for a water works system to cost about $60,000. E. W. Patterson, city clerk.

Central City, Ia.—A bond issue for the construction of a water works plant and distribution system has been voted.

Laurel, Md.—The construction of a reservoir and dam to cost about $1,000,000 is contemplated by the government.

Brookline, Mass.—Constructing water works improvements as follows, is contemplated: 42-inch pipe line 8 miles in length, 2 concrete dams and 4,000 feet of tunnel. R. N. Clark, city engineer.

St. Joseph, Mo.—Extensive improvements at the pumping station of the water company, to cost approximately $178,000, are to be made soon. Chas. H. Taylor, superintendent.

St. Paul, Minn.—A $100,000 bond issue for water works improvements has been voted.

Wolfesboro, N. H.—Chas. H. Bartlett is preparing plans for a water works extension to cost about $13,000.

Collingswood, N. J.—The construction of a municipal water works plant is contemplated. A. B. Rogers, engineer.

Geneseo, N. Y.—A $10,000 bond issue for the construction of a concrete or steel reservoir has been voted. Geo. R. Meeker, superintendent of water works.

Schenectady, N. Y.—An appropriation of $30,000 will be made by the city to install water meters in residences. F. W. Bentley, water superintendent.

Syracuse, S. Y.—George H. Beebee, engineer, is preparing plans for water works extension.

Wolcott, N. Y.—The construction of a municipal water works system is contemplated. C. C. Hopkins, engineer, of Rochester, has been engaged.

Gastonia, N. C.—Water works extensions to cost about $17,500 are contemplated.

Byesville, O.—H. L. Maddocks, 504 Newark Trust Bldg., Newark, O., is preparing plans and estimates for the construction of a complete water supply system, to cost about $50,000.

Hubbard, O.—A $30,000 bond issue for the installation of a water works system has been voted.

Lisbon, O.—A resolution has been adopted for issuing of $10,000 in bonds for increasing the water supply. Mayor B. F. Hennacy.

Senecaville, O.—H. L. Maddocks, Newark, O., is preparing plans and estimates for a $40,000 water works system.

Steubenville, O.—The purchase of 6,000,000 gallon pump has been recommended by Director of Service Gavis.

Youngstown, O.—Reservoir construction to cost about $900,000 is contemplated for the coming season.

Coatesville, Penn.—Alexander Potter, New York City, has been retained to prepare plans and supervise the construction of a complete water supply system.

Pittsburgh, Pa.—Extensive improvements to the water works system have been recommended by director of public service Armstrong. Among the improvements are the following: pumping station improvements, $120,000; pipe line extensions, $543,000; filtration plant improvements, $175,000; additional meters, $60,000; reservoir improvements, $25,000.

Harlington, Tex.—A $21,500 bond issue for water works and electric lighting plants has been voted.

Franklin, Va.—The Phowan Water and Power Corporation has been incorporated for $50,000, by E. W. Cary, W. O. Bristow and G. C. Stephenson.

Kamloops, B. C., Can.—A $60,000 bond issue for water works extension has been voted.

Vancouver, B. C., Can.—Water works extensions to cost about $625,000 are contemplated.

Ottawa, Can.—The city engineer has been directed to prepare plans and estimates for a sand filtration system.

BRIDGES.

BIDS REQUESTED.

Washington, D. C.—March 6. Furnishing and erecting one 100 foot steel truss highway bridge for the Shoshone project, Wyoming. United States Reclamation Service, Washington, D. C.

Jacksonville, Fla.—March 1, 10 a. m. Furnishing and erecting two wooden bridges on the Fernandina road. Gail L. Barnard, county engineer.

Salem, Ind.—March 4, 1:30 p. m. Constructing one concrete bridge. Frank F. Munkle, auditor.

Warren, Minn.—March 2, 4 p. m. Constructing bridges as follows: 12 corrugated steel arched bridges; 40 corrugated steel culverts with concrete bulkheads; 40 small culverts without bulkheads. A. G. Lundgren, Marshall county auditor. J. H. Baugh, engineer.

Carthage, Mo.—March 7, 2 p. m. Bridge construction as follows: Number 1, the Purcell bridge and trestle approach; Number 2, the Moss Springs bridge; Number 3, the Johnson bridge. Certified check $300. William Kohlman, county engineer.

Delaware, Ohio.—March 11, 12 m. Constructing the super-structure of the Worline bridge. Certified check $200. W. H. Whittier, county surveyor.

Lisbon, Ohio.—March 4, 1 p. m. Constructing steel bridge Number 48 over Cherry Fork Creek. Certified check $200. H. B. McCamon, president board of Columbiana county commissioners.

Toledo, Ohio.—March 5, 10 a. m. Constructing complete floor system for a bridge across the Maumee river. Certified check $200. C. E. Stinebaugh, auditor of Wood county. Chas. A. Sanzenbacher, auditor of Lucas county.

Norristown, Pa.—March 12, 12 m. Removing wooden bridge and stone pier and constructing a steel girder highway bridge. Certified check $1,000. Robert C. Miller, clerk Montgomery county commissioners.

Milton, Ont., Can.—March 4, 12 m. Constructing 135-foot reinforced concrete arch and 340 feet of concrete viaduct approach on the Middle Road. Frank Barber, 57 Adelaide st. east, Toronto, engineer.

CONTRACTS AWARDED.

Jonesboro, Ark.—Constructing a steel bridge across St. Francis Lake, to the Vincennes Bridge Co., Vincennes, Ind.

Lake City, Ark.—Constructing steel bridge across St. Francis Lake, to the Vincennes Bridge Co., at $64,900.

Tucson, Ariz.—Constructing stone bridge, to Griffith and Pachao, about $20,000.

Grand Junction, Colo.—Constructing a bridge over the Grand river, to the Patterson Bridge Co., Denver, Colo., $67,215.

Marietta, Ga.—Constructing a bridge over Power street, to the Virginia Bridge and Iron Company, Atlanta, Ga.

Charleston, Ill.—Constructing a bridge across the Ryan ford, to Groggin & Company, Arcola, Ill.

Havanna, Ill.—Repairing a bridge across the Illinois river, to the Joliet Bridge and Iron Co., Joliet, Ill.

Newport, Ind.—Erecting two bridges in in Vermillion county, to the Central States Bridge Co., Indianapolis, $22,043.

Cedar Rapids, Ia.—Constructing three bridges, to the Clinton Bridge Company, Clinton, Ia., $8,250.

Coffeyville, Kan.—Constructing 32-ft. span reinforced concrete bridge over Turkey creek, to Nelson Bros.

New Orleans, La.—Erecting bascule bridge over the New Basin Canal at Hagan avenue, to Midland Bridge Co., $22,900.

Baltimore, Md.—Constructing steel bridge on South Monroe st., to McClintick-Marshall Construction Co., Philadelphia, Pa., $17,575.

St. Joseph, Mich.—Constructing a viaduct at First st., to the Elkhart Bridge and Iron Co., Elkhart, Ind.

Linneus, Mo.—Constructing 14 steel bridges, to the Monarch Engineering Company.

Marion, O.—Building super-structure of the Radnor pike bridge, to Horn Engineering & Contract Co., of Canton.

Portland, Ore.—Constructing Broadway bridge, to the Pennsylvania Steel Co.

Philadelphia, Pa.—Constructing roadway and bridge across Barnegat Bay, New Jer-

sey, from Manahawken to Long Beach, to the General Contracting and Engineering Co., New York City, $75,000.

Aberdeen, S. D.—Constructing four steel concrete bridges and repairing two steel bridges in Brown county, to C. E. Gilbert. Improved Corrugated Culvert Co., Aberdeen, S. D., $12,971.

Chattanooga, Tenn.—Constructing bridges and culverts, to J. P. Nolan & E. F. Malone.

Olympia, Wash.—Constructing sub-structure of the Lewis river bridge, near Woodland, to the Jahn Construction Co., of Seattle, Wash., $16,565.

Olympia, Wash.—Constructing a bridge over the Skagit river, to D. M. Stevenson, Portland, Ore., $29,494.

Seattle, Wash.—Constructing the Patten Bridge, to C. J. McHugh, Seattle, Wash., $13,310.

Woodland, Wash.—Constructing the approaches and piers for bridge across the Lewis river, to the Jahn Construction Co., Seattle, Wash., $60,000.

CONTEMPLATED WORK.

Birmingham, Ala.—Plans for a viaduct on Twentieth st. have been informally submitted to President Exum, of the commission.

Ft. Smith, Ark.—A new bridge over the Arkansas river, connecting Ft. Smith and Oklahoma, is contemplated.

San Diego, Cal.—Constructing bridge over canyon at Nutmeg and Laurel sts., is contemplated. D. K. Adams, superintendent of streets.

Kissimee, Fla.—A $25,000 bond issue for curbing, grading and paving has been voted.

Danville, Ill.—The state highway commission is preparing plans for the construction of an 850-ft. reinforced concrete bridge. A. N. Johnson, state highway commissioner, Springfield, Ill.

Maywood, Ill.—Westcott and Ronneburg, 1107 Security building, Chicago, Ill., are preparing plans for a 200-ft. reinforced concrete arched bridge.

Moline, Ill.—The Henry county board of supervisors have decided to appropriate $30,000 for the erection of a bridge across the river at Colona.

Rock Island, Ill.—The county supervisors have appropriated $30,000 for constructing a new bridge across the Rock river at Colona.

Peru, Ind.—A $12,000 bond issue for bridge improvements has been voted.

Sioux City, Ia.—The construction of a bridge over the Missouri river is contemplated.

St. Joseph, Mo.—Plans and specifications for a system of concrete viaducts in Sixth, Mary and Monterey sts. and Mitchell ave. have been prepared by I. V. Cochrane.

Cranford, N. J.—The erection of a $12,000 bridge over the Rahway river at South ave. is contemplated.

Buffalo, N. Y.—The construction of a bridge across the canal at Ferry st. is contemplated.

Statesville, N. C.—A $400,000 bond issue for highway construction, including a number of steel highway bridges, has been voted. W. S. Fallis, county engineer.

Dayton, O.—E. C. Cummin, city engineer, has recommended the appropriation of $10,000 for the proposed Keowee st. bridge.

Youngstown, O.—F. M. Lillie, city engineer, has prepared plans for bridges to be constructed in Lincoln Park.

Pittsburg, Pa.—Bids will soon be asked for constructing a bridge on Atherton ave., over the P. R. R., at an estimated cost of $100,000.

Memphis, Tenn.—A new bridge across the Mississippi river at Memphis is contemplated.

Fort Worth, Tex.—A $1,600,000 bond issue for road and bridge improvements has been issued by the county commissioners.

Petersburg, Va.—A $212,000 bond issue for bridge construction and street improvement has been voted.

Spokane, Wash.—The construction of steel and concrete bridges to cost about $60,000 is contemplated, for the early spring.

Tacoma, Wash.—The construction of a steel bridge to cost $25,000 is contemplated by the municipal commission.

Milwaukee, Wis.—A $175,000 bond issue for a bridge at Buffalo st. has been voted.

STREET LIGHTING.

BIDS REQUESTED.

Helena, Mont.—March 4. Furnishing 127 one-lamp ornamental lighting posts. Chas. W. Helmick, city engineer.

Cincinnati, O.—March 4, 12 m. Furnishing electric generating machinery, etc., for the village of Madisonville, O. Director of public service, city hall.

Pittsburg, Pa.—Feb. 19, 10 a. m. Furnishing all material necessary to keep in good condition and light the streets, boulevards, alleys, parks, etc., of the city of Pittsburg for a term of five years. William A. Magee, mayor; Joseph G. Armstrong, director, department of public works.

CONTEMPLATED WORK.

Atlanta, Ga.—The J. B. McCrary Co. has been called upon to give advice relative to improving lighting conditions, including a new electrical power plant.

Chicago, Ill.—The Lincoln Park commissioners contemplate extending, boulevarding and illuminating Sheridan road for 30 miles north from Devon ave.

Peoria, Ill.—The city clerk has been instructed to advertise for bids for lighting the streets for a period of years. Lighting extension, including ornamental lights, is planned.

Burlington, Ia.—The Commercial Exchange is securing contracts for an ornamental lighting system.

Coggon, Ia.—A new municipal electric light plant is contemplated.

Manson, Ia.—H. R. Healy, Corpus Christi, Tex., has purchased the lighting plant.

Keokuk, Ia.—Plans are being prepared for installing a curb lighting system on Main st.

Atchison, Kan.—The construction of a municipal light plant is contemplated. C. B. Walker, mayor.

Cumberland, Md.—The construction of a municipal lighting plant is contemplated. Harry L. Smith, commissioner.

Fenton, Mich.—The construction of a municipal lighting plant is contemplated.

Grand Rapids, Mich.—Definite action has been taken and the Retail Merchants' Association is raising the necessary funds for the construction of an ornamental lighting system.

Kalamazoo, Mich.—The installation of an ornamental lighting system is being urged.

Tarkio, Mo.—The purchase of the electric light and water company's plant is contemplated.

Kearney, Neb.—The installation of a municipal lighting system in Kearney is contemplated. Geo. G. Ford, city clerk.

Millville, N. J.—A municipal electric lighting plant is contemplated.

Yonkers, N. Y.—The United Business Men's Association is agitating the question of ornamental street lighting. Kenneth G. MacKenzie, president.

Cincinnati, O.—The installation of a boulevard lighting system in the downtown district is contemplated.

Cleveland, O.—Fred W. Ballard is preparing plans for the new $2,000,000 electric lighting plant. Contracts for the machinery may be let in May. Mayor Baker.

Salem, O.—The Daily Engineering Co., of Alliance, O., is preparing plans for the construction of an electric lighting plant.

Youngstown, O.—The installation of an ornamental lighting system in Federal st. is contemplated.

Warren, O.—The installation of an electric lighting plant for the court house and jail is contemplated by the county authorities.

Porum, Okla.—Kennedy and Fleming, of Oklahoma City, Okla., have been awarded the contract for the construction of a water works and electric light plant to cost $33,000.

Irving, Ore.—The Oregon Power Co. has been asked to furnish electricity for street lighting purposes.

Amity, Pa.—The installation of a street lighting system is contemplated. Dr. W. L. Dodd.

Conneautville, Pa.—A franchise for furnishing electric lights and power has been granted to S. C. Eckels.

Harrisburg, Pa.—A rearrangement of the street lighting system is being urged by the Board of Trade.

McKeesport, Pa.—The installation of cluster lights in certain portions of the downtown streets is being urged.

New Brighton, Pa.—The construction of a municipal lighting plant is contemplated.

Philadelphia, Pa.—The Kensington Board of Trade desires information concerning an ornamental lighting system. A. B. Keeley, president, 2434 Kensington ave.

Uniontown, Pa.—The installation of an ornamental lighting system is contemplated. The Chamber of Commerce is interested.

Beaumont, Tex.—The Beaumont Electric Light & Power Company will construct an ornamental lighting system on Pearl st.

San Antonio, Tex.—The San Antonio Gas & Electric Co. will expend about $300,000 for new equipment and improvements during 1912.

Bellingham, Wash.—The purchase and installation of cluster lights on three streets is contemplated.

Luxemburg, Wis.—The installation of a street lighting system to cost about $4,000 is contemplated.

FIRE APPARATUS.

BIDS REQUESTED.

Iron River, Mich.—March 7, 7 p. m. Furnishing combination chemical and hose wagon. Certified check, $75. James B. Henley, clerk.

CONTEMPLATED WORK.

Los Angeles, Cal.—The purchase of three motor combination pumping engines has been recommended.

Washington, D. C.—An American consul in a foreign country states that cities in his district desire American fire apparatus. Address Bureau of Manufacturers, No. 8157.

The following members of the city council have been appointed to investigate motor fire apparatus: J. M. Vickery, W. E. Crawford and J. P. Edwards.

Southington, Conn.—The purchase of motor fire apparatus is contemplated.

Quitman, Ga.—A $12,000 bond issue for fire department improvement has been voted.

Waycross, Ga.—H. Hengeveld, of the fire and police committee, desires information on automobile fire apparatus.

Salina, Kan.—The purchase of motor fire apparatus is contemplated.

Benton, Ky.—Bids will be asked soon for an automobile fire engine.

Middleboro, Mass.—The purchase of motor fire apparatus is contemplated. Chas. M. Hutchison.

Rockland, Mass.—The purchase of an automobile truck is contemplated.

Wakefield, Mass.—A committee has been appointed to investigate motor fire apparatus with a view to purchase. W. E. Cade, chief and president of committee.

Flint, Mich.—The purchase of a motor-driven combination pump and hose wagon is contemplated.

Rochester, Minn.—The purchase of a triple combination automobile chemical and fire engine to cost about $9,000 is contemplated.

Dunkirk, N. Y.—The purchase of an automobile combination motor chemical and hose wagon is contemplated.

Ogdensburg, N. Y.—A $20,000 bond issue for the construction and equipment of a central fire station has been authorized.

Tuckahoe, N. Y.—The town of East Chester will purchase a fire engine; estimated cost, $8,000.

Scranton, Pa.—$41,000 has been appropriated by the council for the purchase of new equipment for the fire department.

Salem, Ore.—A committee has been appointed to investigate motor fire apparatus.

Saskatoon, Can.—A $94,000 bond issue for storm sewer construction has been voted. E. T. Clark, city engineer.

Nanaimo, B. C., Can.—The purchase of an automobile chemical engine, hose cart, automobile pumping engine, etc., has been recommended.

GARBAGE DISPOSAL, STREET CLEANING AND SPRINKLING.

CONTRACTS AWARDED.

Aurora, Ill.—Constructing garbage crematory, to the Dixon Engineering and Contracting Co., Toledo, O., $9,316.

Boston, Mass.—Disposal of the city's refuse for ten years, to the Boston Development & Sanitary Co., $1,432,000.

Boston, Mass.—Collecting and removing ashes, etc., in the South Dorchester district to the S. S. and A. B. Gore Corporation, Boston, Mass., $1,540; collecting and removing ashes, etc., in North Dorchester district to the F. S. and A. B. Gore Corporation, $2,037; collecting and removing garbage in the Dorchester district, to the F. S. and A. B. Gore Corporation, $1,881; collectin and removing garbage in the east Boston district, to John E. Lane, $416; collecting and removing ashes, etc., in the Hyde Park district, to Thomas Corrigan, $350; collecting and removing ashes, etc., in the Brighton district, to John McNamara, $990; collecting and removing ashes in East Boston, to Antonio De Sano, $958.

CONTEMPLATED WORK.

Martins Ferry, O.—The city council is considering the construction of an incinerating plant for the disposal of garbage.

McKees Rocks, Pa.—A new garbage disposal plant is contemplated. Louis F. Kellerman, president council.